Massachusetts Volunteer Coastal Monitoring General Quality Assurance Project Plan (QAPP)

Version 1.1

For Water Quality Monitoring, Wetland Biological Assessments, and Marine Introduced Species Monitoring

Prepared by:
Jerry Schoen (Massachusetts Water Watch Partnership)
Barbara Warren (Salem Sound Coastwatch)

Under contract with the
Commonwealth of Massachusetts
Executive Office of Environmental Affairs
Massachusetts Office of Coastal Zone Management
251 Causeway St., Suite 800
Boston MA 02114

Reviewed by:
Massachusetts Department of Environmental Protection
Division of Watershed Management
627 Main Street
Worcester, MA 01608

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Acknowledgements

This General QAPP was written by Jerry Schoen (Massachusetts Water Watch Partnership) and Barbara Warren (Salem Sound Coastwatch) under contract with the Office of Coastal Zone Management (CZM). Reviewers included Jay Baker and Todd Callaghan, CZM; and Arthur Screpetis, Richard Chase and Richard Alden, Massachusetts Department of Environmental Protection (MassDEP). For more information, contact Todd Callaghan, CZM 617-626-1233.

How to Use This QAPP

"The Quality Assurance Project Plan (QAPP) outlines the procedures a monitoring project will use to ensure that the samples participants collect and analyze, the data they store and manage, and the reports they write are of high enough quality to meet project needs." (*The Volunteer Monitor's Guide to Quality Assurance Project Plans*, US EPA 1996).

This General QAPP is intended to serve all organizations participating in the Office of Coastal Zone Management's (CZM) Coastal Monitoring Grants program, and may also serve programs collaborating with other state agencies. It contains baseline requirements to be met for data collection projects, as well as common objectives, parameters, methods and approaches for river, lake, wetland, and coastal chemical and biological monitoring. The General QAPP can be adopted as the project QAPP by any group performing these types of monitoring activities. If not adopted, an individual project QAPP is typically required and the General QAPP may be useful as a template for a project-specific QAPP.

Individual groups adopting this General QAPP must follow these steps:

1) **Carefully review the General QAPP to ensure that the proposed monitoring program meets the General QAPP's requirements.**

2) **Complete the "*General QAPP Adoption Form*" found in Appendix 1. This form is made up of a series of templates that must be filled out by each monitoring organization. Instructions for completing each element of the *General QAPP Adoption form* are found in the corresponding numbered chapter of the General QAPP.**

3) **Submit only the *General QAPP Adoption Form* for review and approval by CZM and DEP (see Chapter 1 for more information).**

Note: Groups that submit the *General QAPP Adoption Form* will not be required to develop a stand-alone QAPP for their respective projects.

Additional guidance on establishing monitoring goals that are specific to a particular program can be found in *The Massachusetts Volunteer Monitor's Guidebook to Quality Assurance Project Plans* http://www.mass.gov/dep/brp/wm/files/qapp.pdf. This guidebook contains advice (pages 7 and 8) on the time required to undertake this process. In general, program planning and development of the *General QAPP Adoption Form* should begin approximately five to six months prior to beginning the actual sampling program.

The General QAPP is available at http://www.mass.gov/czm/, or by request to CZM or MassDEP. For more information, contact Jay Baker, CZM 617-626-1204.

Summary of Requirements for Adopting the General QAPP

1) The *General QAPP Adoption Form* must be submitted to DEP and CZM for review and approval. The General QAPP Adoption Form has been approved once the signature approval page is completed.

2) Include in the *General QAPP Adoption Form* a table of contents containing the 24 QAPP elements.

3) The *General QAPP Adoption Form* must be distributed to major project participants.

4) The project must have an organized structure for effective communication and completion of tasks.

5) The *General QAPP Adoption Form* must document sufficient background knowledge, demonstrated need, and defined objectives.

6) The *General QAPP Adoption Form* must summarize basically what the project entails (i.e., who, what, when, where, why, and how data collection will occur), including a task calendar.

7) Clear and achievable data quality objectives for each parameter to be measured in the project must be stated in the *General QAPP Adoption Form.*

8) Instruction in all aspects of project data collection and management shall be provided to project participants (as applicable, depending on assigned tasks) and shall be documented, including trainee signatures, trainer(s), dates of training, and subject matter.

9) Documentation and record-keeping for all project activities related to data collection and data quality shall be implemented for the duration of the project.

10) a. The *General QAPP Adoption Form* must explain the general thought process behind the sampling plan, as well as provide detailed information regarding the "who, what, when, where, why, and how" that was generally referred to in Element 6.

    b. The *General QAPP Adoption Form* must discuss measures to be taken to ensure the health and safety of project participants for the duration of the project.

11) The *General QAPP Adoption Form* must provide detailed information regarding how samples will be collected and preserved, as well as copies of standard operating procedures (SOPs).

12) The procedures used to label, transport, store, and track custody of samples must be explained in the project *General QAPP Adoption Form*.

13) All analytical methods used in the project shall be identified in the *General QAPP Adoption Form* and be based on standardized laboratory methods that are specifically referenced or contained in the project-specific *General QAPP Adoption Form*.

14) Project sampling shall include appropriate field and laboratory quality control samples to assess general data quality issues, as well as specific data quality objectives specified in Element 7 of the project *General QAPP Adoption Form*.

15) The project shall include a systematic process for consistently checking, testing, and maintaining instruments and equipment for proper functioning.

16) All instruments used in the project shall be calibrated at a pre-determined frequency to ensure instrument accuracy and precision for the duration of the project (with logbook documentation).

17) The procurement, inspection, and acceptance of sampling, analytical, and ancillary project supplies shall occur in a consistent and timely manner.

18) The *General QAPP Adoption Form* shall provide detailed information for any non-project data used in developing and implementing the *General QAPP Adoption Form* or in any other way affecting the project.

19) As detailed in the *General QAPP Adoption Form*, the project shall include a data management system.

20) The project shall have a defined process for identifying and effectively addressing issues that affect data quality, personal safety, and other important project components.

21) The project shall include a reporting mechanism for project data. Reporting shall include raw data, QC data, and important metadata.

22) All project data, metadata, and quality control data shall be critically reviewed to look for problems that may compromise data usability.

23) The *General QAPP Adoption Form* shall explain how all project data and metadata are reviewed and approved as usable data (and as un-usable when the data are questionable for any reason).

24) The *General QAPP Adoption Form* shall describe a process whereby resulting data are compared to the planned DQOs in the project *General QAPP Adoption Form* and the results of this analysis are reported.

1. Title and Approval Page

□ General QAPP Requirement #1: Before proceeding with project implementation, recipients of CZM's Coastal Monitoring Grants must have a Title and Approval Page that has been signed by the grantee and the appropriate CZM and DEP agency representatives. See Section 1. of the *General QAPP Adoption Form* in Appendix 1 for a Title and Approval Page Template.

2. Table of Contents

□ General QAPP Requirement #2: Include a table of contents containing the 24 elements of the General QAPP in the *General QAPP Adoption Form*

3. Distribution List

☐ General QAPP Requirement #3: The *General QAPP Adoption Form* must be distributed to the following major project participants:

Required

- Project Manager
- Monitoring Program Coordinator
- Program Quality Assurance Officer
- Program Participants
- Project Field Coordinator
- Project Lab Coordinator
- Richard Chase, DEP QA Officer
  627 Main St., 2nd floor, Worcester, MA 01608
  Phone: (508) 767-2859; Fax: 508-791-4131
  email: richard.f.chase@state.ma.us
- Arthur Screpetis, DEP Technical Reviewer
  627 Main Street, 2nd floor, Worcester, MA 01608
  Phone: 508-767-2875; Fax: 508-791-4131
  email: arthur.screpetis@state.ma.us
- Todd Callaghan, CZM Program Contact
  251 Causeway St, Suite 800, Boston, MA 02114
  Phone: 617-626-1204; Fax: 617-626-1240
  email: todd.callaghan@state.ma.us

Recommended

- Other project participants, contacts, data users
- Town/City Governance
- Conservation Commission
- Regional/Local Planning Office

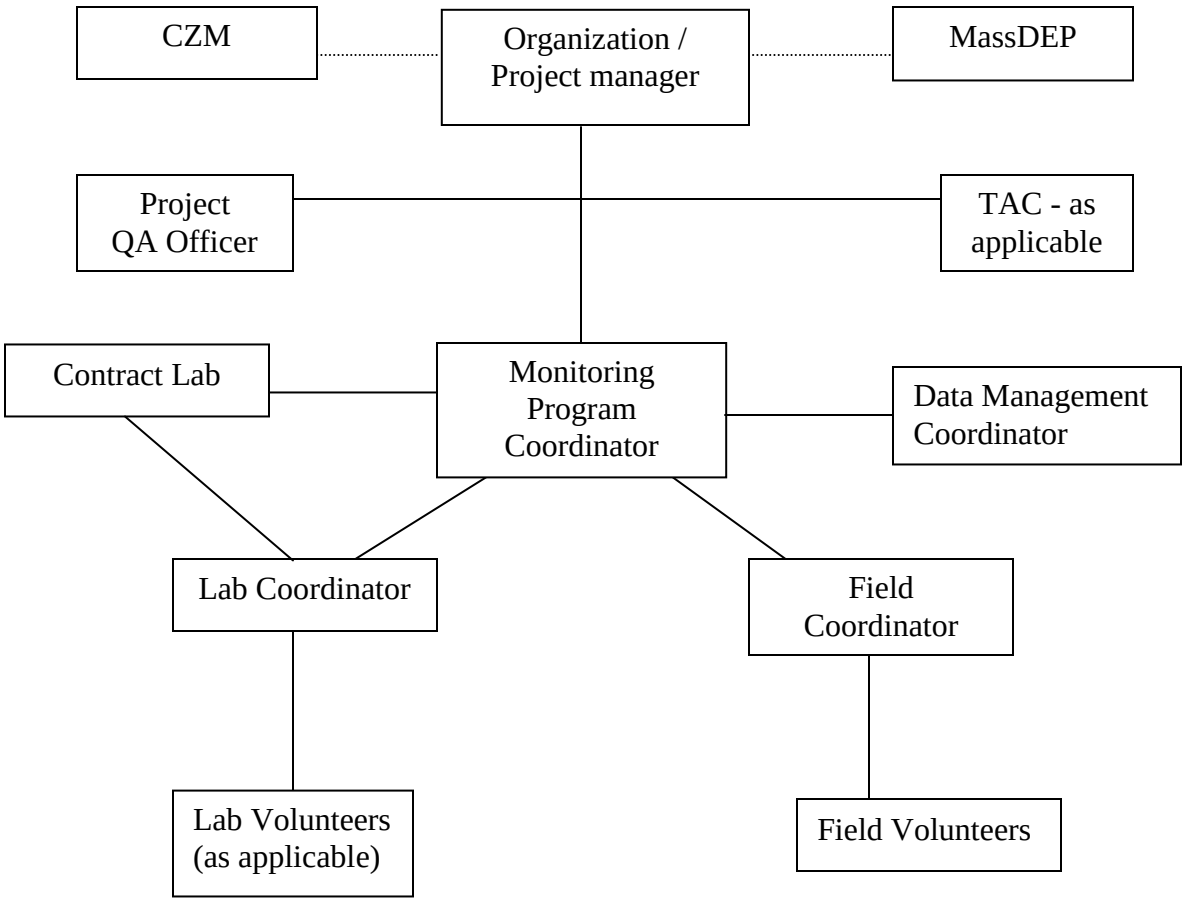
4. Project/Task Organization

☐ General QAPP Requirement #4: The project must have an organized structure for effective communication and completion of tasks.

Table 4.1. Project Organization (typical)
Key project personnel and their corresponding responsibilities

Name(s)	Project Title/Responsibility
Specify in the General QAPP Adoption Form	***Project Manager*** – Oversees all aspects of project that incorporate the monitoring program including: fiscal management, project objectives, data uses, program changes, etc.
Specify in the General QAPP Adoption Form	***Technical Advisory Committee*** (TAC) – Program oversight and advice.
Specify in the General QAPP Adoption Form	***Monitoring Program Coordinator*** (a.k.a. Monitoring Coordinator) – Volunteer recruitment and training, coordination with TAC. Develops *General QAPP Adoption Form*. Produces monitoring report. Produces or oversees outreach efforts, in coordination with project manager.
Specify in the General QAPP Adoption Form	***Lab Coordinator*** – Makes arrangements with any lab(s) used to perform analyses according to QAPP. Ensures correct procedures are used, holding times are met, and adequate documentation is provided.
Specify in the General QAPP Adoption Form	***Field Coordinator*** – Responsible for training and supervising volunteers in field work. Ensures field forms are properly filled out, samples and forms are transported to laboratories as needed; and performs QC checks to make sure procedures are followed or corrected as needed (in collaboration with project QC officer).
Specify in the General QAPP Adoption Form	***Data Management Coordinator*** – Maintains the data systems for the program. Performs/oversees data entry and checks entries for accuracy against field and lab forms.
Specify in the General QAPP Adoption Form	***QA Officer*** – Runs Quality Assurance (QA) program.
Specify in the General QAPP Adoption Form	***Volunteers*** – Sample, perform field analyses, assist in laboratory analyses and/or data entry.
Specify in the General QAPP Adoption Form	***Agency Project Contact*** – Oversees grant administration and ensures reporting requirements are met.
Specify in the General QAPP Adoption Form	***USEPA Quality Assurance Officer*** – Reviews *General QAPP Adoption Form*, as applicable.
Richard Chase	***DEP Quality Assurance Officer*** – Reads QA reports, reviews *General QAPP Adoption Form*, confers with program QA officer on quality control issues that arise during the course of a monitoring program.
Arthur Screpetis	***DEP Technical Reviewer*** – Reviews *General QAPP Adoption Form*.

Table 4.2. Typical Organizational Chart: Lines between boxes indicate who communicates directly with whom.



5. Problem Definition/Background

□ General QAPP Requirement #5: The *General QAPP Adoption Form* must document background knowledge, the need for the proposed work, and defined objectives.

The Coastal Monitoring Program supports organizations that monitor coastal systems; coordinates such efforts with state priority projects; and gathers valuable information to support the protection and restoration of important aquatic habitats and natural resources. The document *A Water Quality Monitoring Strategy for the Commonwealth of Massachusetts*, published by the Massachusetts Department of Environmental Protection (DEP), states that citizen monitoring programs "can serve as an important part of a statewide water quality monitoring network." Historically, Massachusetts citizen groups active in coastal wetlands and water bodies have conducted monitoring programs including ground and surface water quality monitoring, wetland biological assessments, and monitoring for introduced species to support the protection and restoration of critical natural resources (e.g. beach and marsh habitats, coastal recreational areas, shellfish habitats, eelgrass beds, etc.). Coastal water bodies generally include brooks, streams, rivers, coastal ponds and coastal wetlands (salt and brackish marshes) that discharge into coastal waters.

This General QAPP addresses monitoring activities related to the following three coastal issues:

Coastal Water Quality: The Commonwealth's coastal watersheds suffer from a number of impairments to water quality, with over 90% of the impaired water bodies in Massachusetts containing elevated levels of bacteria or nutrients. Data collected from this effort are intended to assist DEP in evaluating water bodies that have not yet been assessed, documenting water quality trends necessary for the designation of strategies to remediate the impairment, and evaluating water quality in areas where these strategies are already being implemented.

Wetland Health and Coastal Habitat Assessment: Wetland biological assessments are a critical component of the evaluation of coastal development impacts on important aquatic habitats. Evaluation of these impacts requires not only the collection of water quality data, but also an assessment of the biological response of these systems to anthropogenic factors. These assessments will aid the Commonwealth in establishing baseline conditions, measuring the scale of the impacts to these systems, and assessing the response of wetlands to restoration efforts.

Marine Introduced Species: Introduced (nonindigenous) species also pose a significant threat to coastal waters, with over 90 nonindigenous species having been documented in the waters of the Gulf of Maine. While the economic losses associated with introduced species have been estimated at hundreds of millions to billions of dollars nationwide, very little effort has been dedicated to monitoring for new infestations. Introduced species monitoring efforts will allow the Commonwealth to better understand vectors of introduction, analyze population dynamics, and eradicate new introductions before they spread.

Studies funded by the Coastal Monitoring Grants typically include one or more of the following objectives:

1) **Provide quality-controlled data that support the assessment and restoration of coastal watersheds and critical habitats** through the implementation of Commonwealth programs such as:
   i) DEP's 305(b) water body health assessments and TMDL development for impaired waters

ii) Clean Water Act Section 319 projects
iii) Massachusetts Aquatic Invasive Species Management Plan
iv) EOEA's watershed action plans
v) National Estuary Programs' Comprehensive Management Plans
vi) CZM's Nonpoint Source Pollution Remediation Program
vii) Commonwealth's Beaches Act
viii) CZM's Wetlands Restoration Program

2) **Leverage the Commonwealth's funds to increase the collection of quality data.** A primary goal of data collection is to produce data of known and documented quality, in support of state water body health assessments, Total Maximum Daily Load (TMDL) programs, municipal infrastructure improvements, Clean Water Act Section 319 projects,305(b) water quality reports, the MarineID database and other state and regional quality controlled databases, agency program decisions including the Massachusetts Wetlands Restoration Program, local-level decisions, and public education on the condition of local waters and coastal habitats.

3) **Watershed/Wetlands health assessment.** This objective is to assess the ecological health and water quality status, relative to the attainment of designated uses as described in the Surface Water Quality Standards (314 CMR 4.00), of selected surface waters and watersheds. Information objectives include addressing specific baseline data needs, monitoring for changes in watershed/wetlands health, and evaluating the need for restoration or mitigation efforts. These objectives will be met by collecting multiple samples per year, at fixed stations, for a given number of years. Details are provided in Sections 10 and 11, and in a program-specific *General QAPP Adoption Form*.

4) **Pollution source identification and impact assessment.** Impacts may be positive (e.g., installation of a pollution control system) or negative (e.g. pollution). This objective is met in two stages: 1) source tracking: as necessary to locate suspected impacts, and 2) monitoring known/potential impacts with temporal or spatial bracketing of a particular impact on a schedule chosen to capture discharges and, for comparison purposes, periods when or locations where no discharge occurs, as appropriate.

5) **Marine introduced species assessments.** This objective is to monitor existing nonindigenous marine species and provide early detection of newly arrived species by gathering quantitative information on marine introduced species in a variety of coastal habitats. By collecting data on the location of marine introduced species, state agencies may be better able to determine the extent of a particular marine introduced species and possible methods for spread prevention and/or eradication.

6) **Public education and outreach.** This objective is to train and engage volunteers to develop a better understanding of the importance of water resources and to encourage their fellow citizens to take an active role in the preservation and restoration of their local water bodies and watersheds.

7) **Local infrastructure improvements**. This objective is to evaluate the performance of storm water infrastructure, such as settling basins, retention basins, conveyances, outfall pipes, etc.

8) **Other data use objectives**. *Specify in the General QAPP Adoption Form*

6. Project/Task Description

□ General QAPP Requirement #6: The *General QAPP Adoption Form* must include a brief project summary (i.e., what, when, where, why, and how data collection will occur), including a task calendar.

For coastal water quality monitoring under this QAPP, data can be collected at regular intervals throughout the sampling season, the duration of which is determined by the project team. Some data (particularly macroinvertebrate and plant surveys) can be collected once during the sampling season. Other data can be collected monthly or weekly. In addition, some data may be collected continuously over a brief period of time, either using landside or instream monitoring devices. Sites are selected to reflect representative, average conditions in a water body – at least one site per river reach of interest, lake, wetland, or coastal embayment; two or more for estuarine sampling. In stratified or deep water bodies, data can be collected vertically such that at least one sample is taken in each vertical segment of interest.

Some impact assessment monitoring may depart from this general schedule in order to temporally bracket discharge periods (e.g. during wet and dry events, before and after changes of land use, before and after installation of pollution control systems, etc.). Impact assessment monitoring of sites of interest can also be spatially bracketed (e.g. upstream/downstream of suspected pollution sources in rivers, near/far from sources, such as lakes, bays and wetlands). Where applicable, tidal cycle influence must be taken into account when conducting impact assessments.

The type of sample information that can be collected under this General QAPP includes, but is not limited to:

- Water depth and depth of sample location
- Secchi disk measurements for water clarity / transparency
- Depth of the sample site
- Light intensity at the location and depth of interest
- Chlorophyll-*a* concentrations as an estimate of algal populations
- Phosphorus and nitrogen forms to measure nutrient levels
- Salinity to gauge its influence on coastal plant and animal communities and to determine stratification (e.g., when collected along depth profiles)
- Turbidity, solids, and conductivity to evaluate the presence of dissolved or suspended materials in the water column
- Dissolved oxygen concentration and percent saturation to determine the amount of oxygen available for aquatic life and to determine if stratification occurs (e.g., when collected along depth profiles)
- Temperature to determine the suitability of habitat for aquatic life and to determine if stratification occurs (e.g., when collected along depth profiles)
- Alkalinity and pH to determine if the waterbody is affected by acid deposition
- Presence of nonindigenous plants/animals to track the existence, spread, and/or success of removal efforts for invasive species
- Bacteria and viruses to evaluate health risks associated with recreation or shellfish consumption
- Dinoflagellates and their toxic products to evaluate health risks associated with recreation or

shellfish consumption (e.g., during Harmful Algal Blooms)

- Detection of optical brighteners/fluorescent whitening agents (FWAs), caffeine, and pharmaceutical and personal care product metabolites to indicate the presence of sewage
- Biological monitoring to determine the nature of plant and animal communities and their response to any changes in water quality or habitat condition.

In general, draft data are typically recorded on field and lab sheets and reviewed for quality control. Final data are transferred to computer spreadsheets and reports, and distributed to the project team (as applicable). The final data may be compared to state water quality criteria or, when no criteria exist, scientific literature, such as ecoregional nutrient criteria or indices provided in methods manuals (e. g. *Freshwater Wetlands Invertebrate Monitoring Protocol*). The Monitoring Coordinator will develop findings and conclusions, which can be incorporated into a study report for dissemination to the QAPP distribution list, the local press, and other stakeholders via paper or electronic media. Results may also be disseminated at times throughout the sampling season via web sites, press announcements, or at informational kiosks at public water access locations, etc.

Annual Task Calendar

This represents a revolving calendar. Some tasks may continue into the following year (e.g. specimen identification, data interpretation and reporting). Specific details are located in the project-specific *General QAPP Adoption Form*.

Table 6.1 Anticipated Schedule (typical; variable, dependent on individual programs)

Activity	J	F	M	A	M	J	J	A	S	O	N	D
Kickoff meeting with project team	X											
Develop draft *General QAPP Adoption Form*	X	X										
Finalize *General QAPP Adoption Form*			X									
Meeting with agency representatives		X	X									
Equipment inventory, purchase, inspection, and testing	X	X	X									
Field training and database-related training session(s)			X	X	X	X						
Meeting with analytical laboratory		X	X	X								
Lab training sessions (in-house analyses)		X	X	X	X	X						
Sampling surveys				X	X	X	X	X	X	X		
Data entry					X	X	X	X	X	X	X	
Data review and validation					X	X	X	X	X	X	X	
Field audit(s)					X	X	X	X	X	X		
Lab audit(s)			X	X	X	X	X	X	X			
Draft report									X	X	X	
Final report										X	X	X
Data uploads to website	X	X	X	X	X	X	X	X	X	X	X	X
Other												
Other												

7. Measurement Quality Goals

□ General QAPP Requirement #7: Clear and achievable data quality objectives for each parameter measured in the project must be stated in the *General QAPP Adoption Form*.

Taken together, precision, accuracy, representativeness, completeness, and comparability comprise the major data quality indicators used to assess the quality of the program's data.

- **Precision** is the degree of agreement among repeated field measurements of the same indicator and gives information about the consistency of your methods. It is typically defined as relative percent difference, or RPD.
- **Accuracy** is a measure of confidence that describes how close a measurement is to its "true" or expected value.
- **Representativeness** is the extent to which measurements actually represent the true environmental condition. Parameters, site selection (including location of sampling point within the water column), time, and frequency of sample collection can all play a role in determining how representative a sample is.
- **Comparability** is the extent to which data can be compared between sample locations or periods of time within a project, or between different projects.
- **Completeness** is the comparison between the amount of valid or usable data the program originally intended to collect versus how much was actually collected.

Typical **precision** objectives are listed in Table 7.1. Precision is often evaluated in the field by participants taking duplicate measurements for at least 10% of samples, where applicable. (The frequency of field duplicate measurements for each parameter must be described in Table 14.1).

Typical **accuracy** objectives are also stated in Table 7.1. Procedures used to test or ensure accuracy are described in Table 14.1. While training and audits help to ensure measurement accuracy and precision, quantitative measures of accuracy for water quality monitoring are usually estimated using laboratory QC data (blank results, fortified matrix results, known QC samples, etc). The accuracy of biological sample identifications and assessments can be verified via expert taxonomic review.

Most sampling sites are selected to be **representative** of the waterbody (or in the case of hotspot monitoring, of the pollution source of interest). Sample collection timing and frequency is selected to capture data that are representative of target conditions (e.g. a range of water levels, weather, seasons, etc.).

The **comparability** of the data collected can be assured by using known protocols and documenting methods, analysis, sampling sites, times and dates, sample storage and transfer, as well as laboratories and identification specialists used so that future surveys can produce comparable data by following similar procedures.

Project monitoring should attempt to maximize the **completeness** of the dataset. At least 80% of the anticipated number of samples are typically collected, analyzed and determined to meet data quality objectives for the project to be considered fully successful. In the end, however, any quality-controlled data are usually considered useful in some way. A report detailing the number of anticipated samples, number of valid results, and percent completion (number of valid samples/number of anticipated samples) for each parameter is typically produced.

Table 7.1. Data Quality Objectives (for common parameters)

Parameter	Units	Accuracy [2]	Overall Precision [1] (RPD)	Approx. Expected Range
Total Kjeldahl Nitrogen	mg/l	80% - 120% recovery of lab fortified matrix (LFM)	30%	0-2
Total Nitrogen	mg/l	80% - 120% recovery of lab fortified matrix (LFM)	30%	0-2
Ammonia (NH3)	mg/l	80% - 120% recovery of lab fortified matrix (LFM)	30%	0-0.5
Nitrate-Nitrite (NO_3-NO_2)	mg/l	80% - 120% recovery of lab fortified matrix (LFM)	30%	0-0.5
Phosphorus - all forms	mg/l	80% - 120% recovery of lab fortified matrix (LFM)	20%	0-0.1
Dissolved oxygen (concentration and/or saturation)	mg/l	+/- 0.5	< 20% (between field duplicate samples or readings)	0-12
Temperature	Celsius (C) degrees	+/- 1C	< 10% (between field duplicate samples or readings)	0-35
pH	pH	+/- 0.3	< 20% (between field duplicate samples or readings)	4-10
Alkalinity	mg/l	80% - 120% recovery of lab fortified matrix (LFM)	20%	-5 to 150
Conductivity	micromhos/cm	± 5% of known QC std.	< 20% (between field duplicate samples or readings)	10–1000 fresh 800–50,000+ salt water
Fecal coliform, *E. coli*, Enterococci	colonies/100 ml *or* MPN	Blanks and negatives show no colonies, positives show colonies	30% RPD for log-transformed duplicate data	0-1,000,000
Turbidity	NTUs	90-110% recovery of turbidity std.	± 0.5 NTU if less than 1 NTU or 20% RPD if more than 1 NTU	0-200

Parameter	Units	Accuracy [2]	Overall Precision [1] (RPD)	Approx. Expected Range
Salinity	ppt (or psu)	+/- 1 ppt	< 20% (between field duplicate samples or readings)	0-32 ppt
Macroinvertebrates (rivers, lakes, wetlands)	Individual organism	95% voucher specimens accurately identified to family or order level, verified by experts.	NA	NA
Habitat assessment	NA	NA	< 20% (in scores for each category between two different volunteers); in practice, discuss to achieve agreement on score.	NA
Stream stage (height) measurement [3]	feet (or meters, depending on staff gage type)	+/- 0.1 foot (in general for staff gage reading)	< 10% (between readings by two different volunteers)	NA
Precipitation	inches (rain gage)	+/- 0.1 inch (in general) [2]	< 20% (between two different gages for the same event)	0-3 inches per event
Location by coordinates (GPS)	degrees and decimal minutes (NAD 1983)	+/- 20 feet with Wide Area Augmentation System (WAAS) enabled	Repeated readings to verify coordinates essentially the same	NA
Water clarity (i.e. Secchi disk)	meters	+/- 0.1 meter (in general)	< 20% (between two different readers for same "sample")	0-5 meters
Light Intensity (e.g., Onset HOBO® LI sensor)	lumens m^{-2}	Dependent upon measuring device	Dependent upon measuring device	Dependent upon measuring device
Photosynthetically active radiation (PAR)	umol quanta m^{-2} s^{-1}	Dependent upon measuring device	Dependent upon measuring device	0–3000
Chlorophyll *a*	µg/l (or mg/m3)	75%-125% recovery for lab QC sample (with known chl a content)	$\pm$ 2.0 if $\leq$ 15 or 20% if > 15	0-30
Aquatic plant characterization	Individual organism for ID, % area for distribution	All specimens identified to genus or species with positive taxonomic confirmation of voucher specimens by experts for 100% of samples for first crew survey (% for successive surveys dependent on initial QC)	NA	NA
Station depth	meters	+/- 0.1 meter (in general)	< 20% (between two different readers for same "sample")	0-15 meters
Detergents (CHEMets kit)	mg/l linear alkylbenzene sulfonate (EW325)	unknown	< 20% (between field duplicate samples)	0-3

Parameter	Units	Accuracy [2]	Overall Precision [1] (RPD)	Approx. Expected Range
Pharmaceuticals and Personal Care Products (PPCPs), including caffeine [4]	ug/l	40-140% recovery for LFM and LFB (analyte-specific)	< 20% (between field duplicate samples)	highly variable
DNA markers for human-specific strains of indicator bacteria[5]	Present or absent	Consistent meeting of expected results (human waste samples)	Duplication of results for 10% of samples	NA
Optical Brighteners/ Fluorescent Whitening Agents [6] (absorbent pad/uv light method)	Qualitative: positive, moderately positive, weakly positive, non-detect	Weakly positive or non-detect results for blank control pads	Duplicate results within one qualitative unit.	Non-detect through positive
Optical Brighteners/ Fluorescent Whitening Agents (HPLC Quantitation method)	µg/l	40-140% recovery for Lab Fortified Blank	0-30% between duplicates	0.22-0.66 for OB 0.03-1.30 µg/l for FWA
Wetland Biomonitoring – estuary coastal wetland				
Macroinvertebrates	NA	All preserved specimens accurately identified to family or order level; taxonomic confirmation of voucher specimens by experts.	Standard laboratory procedures; 90% Accuracy of identification when Invertebrate Scientific Advisor examines a minimum of 10% of the original samples	
Nektons	NA	100% Accuracy of identification evaluated by the Scientific Advisor(s)	NA	NA
Birds	NA	100% Accuracy of identification evaluated by the Scientific Advisor(s)	NA	NA
Presence/absence of various species of vegetation (grasses, sedges, eelgrass, macroalgae, etc)	Present or absent	100% Accuracy of identification evaluated by the Scientific Advisor(s); taxonomic confirmation of voucher specimens by experts	NA	0 = Absent 1 = Present
Vegetation Abundance	Percent cover (%) / quadrat (0.25 meter$^{2)}$	NA	NA	0-100
Canopy Height	cm	100% Accuracy of identification evaluated by the Scientific Advisor(s)	1 cm	1-150cm
Vegetation Density	Shoots per quadrat (0.25 meter$^{2)}$	NA	NA	0-500
Location and depth of deepwater and shallow water edge (of eelgrass bed)	Meters from shore and meters below surface (water depth)	NA	0.1m	from shore: 0-1000; water depth: 0-15

Parameter	Units	Accuracy [2]	Overall Precision [1] (RPD)	Approx. Expected Range
Sediment Type	Qualitative	100% Accuracy of identification evaluated by the Scientific Advisor(s); confirmation of voucher specimens by experts	NA	Mud-fine sand-sand – shell - cobble-boulder/rock
Epiphyte and Tunicate Abundance on Eelgrass blades	Present or absent or Percent Cover per quadrat ($0.25m^{2)}$	100% Accuracy of identification evaluated by the Scientific Advisor(s); confirmation of voucher specimens by experts		0 = Absent 1 = Present; or Trace (0-1), Low (2-30), High (31-100)
Presence/absence of eelgrass flowers and seeds	Present or absent	100% Accuracy of identification evaluated by the Scientific Advisor(s); confirmation of voucher specimens by experts	NA	0 = Absent 1 = Present
Presence/Absence of wasting disease	Present or absent	100% Accuracy of identification evaluated by the Scientific Advisor(s); confirmation of voucher specimens by experts	NA	0 = Absent 1 = Present
Eelgrass shoot biomass	Grams dry weight per shoot,	100% Accuracy of identification evaluated by the Scientific Advisor(s); confirmation of voucher specimens by experts	0.1g	>0.1
Eelgrass shoot morphology (leaf area)	cm^2	100% Accuracy of identification evaluated by the Scientific Advisor(s); confirmation of voucher specimens by experts	0.1cm	1-100
Tidal Hydrology	nearest tenth of foot	NA	NA	NA
Land Use	Wetland buffers of 30 meters, 100 meters and 1 kilometer	N/A	NA	NA
Marine Introduced Species				
Invertebrates - presence/absence	Present/absent	100% accuracy to genus or species; taxonomic verification of voucher specimens by Scientific Advisor(s).	N/A	N/A
Invertebrates - coverage	Percent coverage	100% accuracy to genus or species; taxonomic verification of voucher specimens by Scientific Advisor(s).	N/A	N/A
Invertebrates - abundance (count)	Count or categories (abundant, common, uncommon, rare)	100% accuracy to genus or species; taxonomic verification of voucher specimens by Scientific Advisor(s).	N/A	N/A

Parameter	Units	Accuracy [2]	Overall Precision [1] (RPD)	Approx. Expected Range
Algae – presence/absence	Present/absent	100% accuracy to genus or species; taxonomic verification of voucher specimens by Scientific Advisor(s).	N/A	N/A
Algae – coverage	Percent coverage	100% accuracy to genus or species; taxonomic verification of voucher specimens by Scientific Advisor(s).	N/A	N/A
Algae – abundance (count)	Count or categories (abundant, common, uncommon, rare)	100% accuracy to genus or species; taxonomic verification of voucher specimens by Scientific Advisor(s).	N/A	N/A

1) For analytical samples, the objective for overall precision is typically based on the relative percent difference (RPD) of co-located, simultaneous field duplicates

2) "General" accuracy objectives are estimates assuming a true value were known and could be tested; all analytical accuracy objectives (i.e., for samples) include non-detectable concentrations in ambient field blanks.

3) Due to the complexities involved in accurately estimating streamflow, streamflow measurements (volumetric, cfs) should only be performed by experts. Staff gage readings (that are incorporated into a site-specific stage-discharge curve) are more appropriate for volunteer groups. Streamflow measurement for educational purposes is appropriate.

4) PPCPs include such human-sources chemicals as caffeine, acetaminophen, cotinine (nicotine metabolite), codeine, triclosan (antimicrobial), ibuprofen, aspirin, coprostanol, sulfamethoxazole, azithromycin, carbamazepine, cholesterol, etc.

5) Polymerase Chain Reaction (PCR)-type testing for marks of human influence (e.g., septic, wastewater) on water quality can include detection of the Bacteroidetes bacteria human marker in the water sample, detection of the *Enterococcus faecium* esp gene in the water sample, and other published methods.

6) Optical brighteners and fluorescent whitening agents are different terms for chemicals that are added to almost all laundry soaps and detergents, and which are therefore useful indicators of potentially ineffective sewage treatment. .

8. Training Requirements

□ General QAPP Requirement #8: Instruction in all aspects of project data collection and management shall be provided to project participants (as applicable, depending on assigned tasks) and shall be documented, including trainee signatures, trainer signature(s), dates of training, and subject matter.

All members of the project team are required to attend workshops appropriate to the type of monitoring they will conduct. The Monitoring Coordinator shall ensure that volunteers receive appropriate training by organizing and conducting workshops (securing the services of expert trainers as needed) and/or arranging for volunteers to be trained at workshops held by other qualified personnel or organizations. Volunteers failing to attend required training sessions and/or not meeting expectations shall not participate in data collection under this General QAPP.

The Monitoring Coordinator enters training into the project database and records the following information: subject matter (i.e. what type of monitoring and procedures are covered), training course title, date and agenda, name and qualification of trainers, and names of participants trained. Examples of training record forms are provided in Appendix 9.

Wetland biomonitoring requires specific knowledge of species as well as specific sampling protocols for each parameter. Workshops and infield trainings are important resources for volunteers to learn the necessary knowledge to conduct sound data collection. However, supervision by the Field Coordinator of all monitoring activities may be necessary to achieve data quality objectives.

Volunteers monitoring introduced species shall be trained to identify native species and nonindigenous species for a particular region and nonindigenous species that have the potential to become established in the region. Volunteers shall also be trained in monitoring protocols and be able to document pertinent environmental data for the evaluation site. The Field and Monitoring Program Coordinators may be trained to verify species (or the project team may consist of scientists that are capable of accurate species verification).

9. Documentation and Records

□ General QAPP Requirement #9: Documentation and record-keeping for all project activities related to data collection and data quality shall be implemented for the duration of the project.

Field data sheets will be completed on site at the time of sampling. They will include the sample collection date and times, the site name, number and/or location, the type of sampler used, the weather, air and water temperature, and samplers' names. The data sheets will accompany the samples to the drop-off point where the Field Coordinator will collect the samples and data sheets.

Sample Labels will be put on all sample containers (and/or in containers, in the case of macroinvertebrate and macrophyte samples) will include the site name, date, time, location, type of sample, and sampler's name.

Chain of custody (COC) forms will accompany samples from collection sites to laboratories. COC forms will be signed by collectors and all individuals who gain custody of the samples until they arrive at a lab. Information will agree with the label information on the sample bottles. Information such as the ID number, date, time, type of sample, and samplers will be included on the Chain of Custody Form.

Miscellaneous records for **instrument checks, calibrations, and maintenance** will be kept in a logbook.

In addition to field data sheets, **photographs** (digital preferred) shall be taken of each marine introduced species that is encountered at each evaluation site (i.e. minimum one photo per species per season).

Voucher specimens shall be required for specific species that are more difficult to identify and/or are newly arrived species. A list of marine introduced species, their required method of documentation and voucher sampling is in Appendix 8.

The monitoring organization shall obtain all **scientific collecting permits** required by law. In Massachusetts, the Department of Marine Fisheries issues a Special License for Scientific Collection which is required prior to collecting marine specimens. Appendix 8 provides more information on obtaining this permit.

Training records for all volunteers involved in the project must be kept.

The electronic project **database** shall be organized and protected from loss and damage.

10. Sampling Process Design

□ General QAPP Requirement #10a: The *General QAPP Adoption Form* must explain the general thought process behind the sampling plan, as well as provide detailed information regarding the "what, when, how, where and why" that was generally referred to in Element 6.

□ General QAPP Requirement #10b: The *General QAPP Adoption Form* must discuss measures to be taken to ensure the health and safety of project participants for the duration of the project.

Parameters, number and location of sampling sites, sampling time of day, frequency, and season are selected to meet the monitoring objectives listed in Element 5. Typical sampling design components are described below. Project-specific design shall be described in a project-specific *General QAPP Adoption Form*.

Sampling Safety. Personal safety shall be a primary consideration in all activities, including selection of sampling sites and dates, and training programs. No sampling shall occur when personal safety is thought to be compromised. The Monitoring Coordinator and Field Coordinator shall confer before each sampling event to decide whether adverse weather or other conditions pose a threat to safety of field volunteers, and will cancel/postpone sampling when necessary. Sampling shall take place in teams of two or more. Samplers shall wear life vests when sampling from boats or wading in waters under difficult conditions. Samplers shall wear proper clothing to protect against the elements as applicable, especially footwear and raingear. When sampling in rivers, samplers shall estimate flow and avoid sampling when river depth (in feet) times velocity (feet per second) appear to equal 5 or greater, e.g. 1.5 foot depth * 4 feet/second velocity = 6 = unsafe conditions!

Design Considerations. Typical sampling design principles for watershed/waterbody health assessments, impact assessments and marine introduced species assessments are listed in Table 10.1. These are further broken into subcategories for river, lake, beach harbor and wetland monitoring as appropriate. When describing project-specific sampling processes in the program's *General QAPP Adoption Form*, these procedural considerations shall be followed or modified to meet specific monitoring objectives.

Table 10.1. Typical Sampling Approaches

Survey type	Indicators	Number of sample locations	Site location rationale	Frequency, duration, special conditions	Field survey QC
Waterbody/Watershed Health Assessment					
Rivers ▪ inland ▪ coastal ▪ misc. general	▪ DO ▪ Temperature ▪ pH, Alkalinity ▪ Conductivity ▪ TP ▪ TN/TKN ▪ NH3-N ▪ NO3-NO2-N ▪ Fecal coliform ▪ *E. coli* bacteria ▪ Enterococci bacteria ▪ Turbidity ▪ TSS ▪ Salinity (coastal only) ▪ Other	At least one each for selected reach or tributary	Representative [1] of reach or tributary condition	▪ At least monthly ▪ Minimum three "dry" weather surveys ▪ Pre-dawn or early morning DO especially useful	At least one field duplicate sample per bottle group [2] per survey Probe calibration (if not in the lab just prior to survey)
	Macroinvertebrates	At least one each for selected reach or tributary	Representative [1] of reach or tributary condition	Once/year, late summer or fall	Voucher specimens for later identification by expert(s)
	Habitat assessment	At least one each for selected reach or tributary	Representative [1] of reach or tributary condition	Once/year, late summer or fall	At least one duplicate scoring sheet per team per season
	Stream flow characterization	Follow Mass. DFG Riverways Program guidance [3]			
	Precipitation	At least one per watershed, preferably one per sub-watershed or within 10 miles of sampling sites	Capture storm events that influence conditions at sampling sites	Continuous gages preferable. At least sample within 24 hours prior to sampling event.	Check for reasonableness (e.g. values consistent with predicted rainfall); duplicate readings by two personnel; compare with other local rain stations

Survey type	Indicators	Number of sample locations	Site location rationale	Frequency, duration, special conditions	Field survey QC
River	GPS: Latitude/Longitude in decimal degrees; NAD83/WGS84 coordinate system	Each sampling site	NA	Once per year to mark site; each visit to sampling site if site is not easily marked (e.g. center of lake or longitudinal river profile)	Repeat readings to verify coordinates
Lakes ▪ inland ▪ coastal	▪ DO ▪ Temperature ▪ pH, Alkalinity ▪ Conductivity ▪ TP ▪ TN/TKN ▪ Secchi depth ▪ Chlorophyll a ▪ Station depth ▪ Salinity (coastal ponds only)	At least one at each mid-lake area or deep spot (>1 for some lobed lakes).	Representative of lake condition. [4] DO, temperature sampled in a depth profile at 1 meter increments Chlorophyll a at the surface (grab) or depth-integrated using tube (2X Secchi depth) TP/TN at the surface (~6-12" below water surface) TP at 1 meter above bottom if DO is < 1mg/l at this depth	At least monthly (April-October).	At least one field duplicate sample per bottle group [2] per survey Probe calibration (if not in the lab just prior to survey)
	Aquatic plant characterization (qualitative)	Whole lake	areal density and plant type/species maps for lake footprint	Once/year, late summer or fall	Voucher plant specimens for later identification by expert(s)
	Macroinvertebrates (freshwater)	At least one each lake, ≤ 30 meter upslope of outlet, on vegetation bed	Avoid overemphasis of tributary streams; reflect lake processes	At least once per year – summer or fall.	Voucher specimens for later identification by expert(s)
	Habitat assessment	One for each lake	Representative [1] of reach or tributary condition	Once/year, late summer or fall	At least one duplicate scoring sheet per team per season
Beaches ▪ lakes ▪ rivers ▪ coastal	▪ Fecal coliform ▪ *E. coli* bacteria ▪ Enterococci bacteria	Follow MA DEP DWM guidance on bacteria sampling at beaches or other applicable guidance [5]			
Harbors, bays, coves, etc. (saline)	See "Rivers" and "Lakes" (as applicable)				

Survey type	Indicators	Number of sample locations	Site location rationale	Frequency, duration, special conditions	Field survey QC
Coastal wetlands	Macroinvertebrates – presence	3 creek bank sites near 0-150-300 feet	Representative of marsh condition at study & reference	Once/year, late summer or fall	Any combination of qualified supervisor, multiple samplers, voucher specimens, photo documentation
	Nekton (fish, shrimp, crabs)– presence, relative abundance	3 equally spaced along evaluation area gradient	Representative of marsh condition at study & reference	Three times June - September	Any combination of qualified supervisor, multiple samplers, voucher specimens, photo documentation
	Birds – point counts of all species seen or heard	Single vantage point overlooking evaluation area	Representative of marsh condition at study & reference	Five times June - September	Any combination of qualified supervisor, multiple samplers
	Vegetation – community composition, percent abundance per species	6 transects, randomly stratified	Representative of marsh condition at study & reference	Once August or September	Any combination of qualified supervisor, multiple samplers, voucher specimens, photo documentation
	Tidal hydrology – difference in tidal range	Two fixed locations: one upstream and one downstream of tidal restriction	Representative of tidal flow between study & reference	Once, every 15 minutes for 6 hours from low to high spring tide	Any combination of qualified supervisor, multiple samplers
	Land Use	Map and orthophoto analysis using three concentric buffers	Representative of land use affects on marsh conditions	Once, unless alterations in land use	Any combination: Two or more personnel conduct separate mappings of same area, compare results, discuss to resolve differences

Survey type	Indicators	Number of sample locations	Site location rationale	Frequency, duration, special conditions	Field survey QC
Impact Assessment					
▪ Rivers ▪ Lakes ▪ Beaches ▪ Harbors ▪ Wetlands	Parameter(s) determined by suspected impact Examples: ▪ TSS ▪ Bacteria	For rivers, at least two sites (one just upstream and one just downstream of impact/source) For source tracking, numerous samples may be needed to find likely source(s) Outfall pipe or stream sample along coastline	Proximity to impact or suspected pollution source	Minimum of three times each site, including wet and dry weather For source tracking, "as needed" to locate source(s) At low tide to capture freshwater flow from land	See "Rivers" QC
Marine Introduced Species Assessments					
▪ Beaches ▪ Harbors ▪ Bays ▪ Coves ▪ Inlets ▪ Coastal ponds	Algae, Invertebrate Presence	Inventory survey of evaluation area	Representative of evaluation area	Once/year, late summer or fall	Any combination of qualified supervisor, multiple samplers, voucher specimens, photo documentation
	Algae, Invertebrate Presence, Abundance and/or Coverage	Minimum of four random 1-meter quadrats or line transects within evaluation area	Randomly selected to be Representative of evaluation area	Monthly from April through October	Any combination of qualified supervisor, multiple samplers, voucher specimens, photo documentation

[1] i.e. not in stagnant water or backwater areas; not in a pipe outfall or confluence mixing zone; not in highly turbulent flows

[2] e.g. "nutrient" bottle group may include TP, TN and NH3-N

[3] as contained in MA DFG "RIFLS" QAPP

[4] i.e. not in atypical areas, but in areas that most approximate the average condition of the lake at the time of the survey

[5] DWM CN document # 104.0

11. Sampling Method Requirements

□ General QAPP Requirement #11: All sample collections shall follow group-specific Standard Operating Procedures (SOPs), as contained or referenced in a project-specific *General QAPP Adoption Form*.

It is also highly recommended that pre-sampling coordination with a laboratory take place to ensure that proposed sample collection procedures (found in the SOPs) meet the needs of the chosen laboratory.

Table 11.1. General Sample Collection Methods [1] ([2] lab-specific)

Survey Type	Sample Type	Parameter(s)	Container Type(s) and Preparation	Minimum Sample Quantity [2]	Sample Preservation	Maximum Holding Time
River water quality ▪ inland ▪ coastal ▪ misc.	In-situ (single and/or multi-probes)	▪ DO ▪ pH ▪ conductivity ▪ temperature ▪ other	---	---	---	---
	▪ Manual grab sample ▪ "Basket" sample [3] ▪ Van Dorn sample [4] ▪ Niskin sample	▪ TKN ▪ TN ▪ TP ▪ NH3-N ▪ NO3-NO2-N	▪ New Whirlpak bag ▪ High density polyethylene (HDPE) ▪ Polypropylene (PP) ▪ Pyrex glass (glass, plastic containers pre-acid-washed with 10% hydrochloric acid)	120 ml per analyte	▪ Freeze immediately ▪ Add H_2SO_4 to pH<2 immediately and refrigerate/ chill to <6°C	▪ 28 days if acidified ▪ Up to six mos. frozen (TP only) ▪
		▪ Fecal coliform ▪ *E. coli* bacteria ▪ Enterococci bacteria	▪ Sterilized HDPE/PP/glass ▪ Whirlpak bag	120 ml per analyte	▪ Sodium thiosulfate if chlorine residual suspected ▪ -refrigerate/ chill to <6°C	▪ Transport to lab within six hours ▪ Analyze within 8 hours of collection
		pH, alkalinity	High density polyethylene (HDPE)	300 ml	refrigerate/ chill to <6°C	Deliver to lab within eight hours of collection. Holding time for alkalinity is 14 days

Survey Type	Sample Type	Parameter(s)	Container Type(s) and Preparation	Minimum Sample Quantity [2]	Sample Preservation	Maximum Holding Time
		TSS	Glass or Plastic	300 ml	refrigerate/ chill to <6°C	seven days
		Turbidity	Plastic	100ml	refrigerate/ chill to <6°C	48 hours
		Detergents (CHEMets kit)	HDPE or amber glass	500 ml.	▪ refrigerate/ chill to <6°C ▪ dark storage	two days
		Optical Brighteners/ Fluorescent Whitening Agents	Amber glass (no pre-rinsing)	1 liter	▪ refrigerate/ chill to <6°C ▪ dark storage	seven days
		Pharmaceuticals and Personal Care Products (PPCPs), including caffeine	Amber glass	500 ml.	▪ refrigerate/ chill to <6°C ▪ dark storage	24 hours
		DNA markers for human-specific strains of indicator bacteria	Same as for bacteria (except sample bottle prep includes bleach wash of PS/HDPE container to remove any DNA/RNA, sterile)			
	Cotton pad sampler (in-situ)	Optical Brighteners/ Fluorescent Whitening Agents	Cotton pads	NA	Keep pads cool and in dark in separate labeled plastic bags	two to three days
	Refractometer Hydrometer	Salinity	NA	NA	NA	NA
	Winkler bottle or reagent kit	Dissolved Oxygen (manual)	"BOD" Bottle	300 ml.	▪ Fix immediately ▪ refrigerate/ chill to <6°C ▪ dark storage	eight hours
	In-situ thermometer (manual)	Temperature	NA	NA	NA	NA
	Velocimeter or Flow meter [5]	Water velocity and streamflow	NA	NA	NA	NA

Survey Type	Sample Type	Parameter(s)	Container Type(s) and Preparation	Minimum Sample Quantity [2]	Sample Preservation	Maximum Holding Time
	Kick nets	Macroinverts	Plastic bottles or zip-lock bags	N/A	preserved in 90% ethyl or isopropyl alcohol until initial sorting to remove debris; 70% alcohol until ID	six months
	Rain gage	Rainfall amount	N/A	N/A	In-situ	N/A
	GPS	Location by coordinates	Latitude/Longitude in decimal degrees; NAD83/WGS84 coordinate system; DQO~ +/- 20 feet with WAAS correction enabled.			
Lakes ▪ inland ▪ coastal	▪ Manual grab sample ▪ Van Dorn sample [4]	▪ TKN ▪ TN ▪ TP	See above for Rivers			
	In-situ (instrumentation)	▪ DO ▪ pH ▪ conductivity ▪ temperature ▪ other	See above for Rivers			
	Secchi disk Viewscope Transparency tube	Secchi depth Transparency	NA	NA	NA	NA
	Manual grab	pH, Alkalinity	High density polyethylene (HDPE)	300 ml	refrigerate/ chill to <6°C	Deliver to lab within eight hours of collection. Holding time for alkalinity is 14 days
	▪ Manual grab sample ▪ Van Dorn sample ▪ Depth-integrated tube	Chlorophyll a	High density polyethylene (HDPE)	1 liter (2 liters if Secchi depth > 3 meters)	Filter on shore, or if delivering unfiltered to lab, refrigerate/ chill to <6°C in dark storage	Unfiltered, fresh-24 hr; Filtered, frozen-21 days; Filtered, forced air-dried-15 days

Survey Type	Sample Type	Parameter(s)	Container Type(s) and Preparation	Minimum Sample Quantity [2]	Sample Preservation	Maximum Holding Time
	Winkler bottle or reagent kit	Dissolved Oxygen (manual)	"BOD" Bottle	60 ml.	▪ Fix immediately ▪ refrigerate/ chill to <6°C ▪ dark storage ▪	eight hours
	Kick nets	Macroinvertebrates	See rivers	See rivers	See rivers	See rivers
		Macrophytes	Newspapers (wet), zip-lock bags	One per species or one per sample	Refrigerate upon return from sample trip.	Several days
Beaches ▪ lakes ▪ rivers ▪ coastal	▪ Manual grab sample ▪ "Basket" sample ▪ Van Dorn sample	▪ Fecal coliform ▪ *E. coli* bacteria ▪ Enterococci bacteria	See above for Rivers			
Coastal wetlands	Ditch or lift nets, bag seine, minnow traps	Nektons	Identified, measured, weighed in situ	3 samples per site	Only if further species verification needed	NA
	In situ	Birds	NA	NA	NA	NA
	In situ, quadrats	Vegetation	NA	NA	Only if further species verification needed	NA
	In situ	Tidal Hydrology	NA	NA	NA	NA
	N/A	Land Use	NA	NA	NA	NA
	D-net, auger, quadrat	Macroinvertebrates	Labeled zip-lock bags	One per sample collected	preserved in 90% ethyl or isopropyl alcohol; refrigerate until initial sorting to remove debris; vials with 70 -90% alcohol until ID	Less than 6 months; after ID archive vials
Harbors, bays, coves, etc. (saline)	Inventory survey	Algae, Invertebrate Presence	Photo or voucher specimen; see list Appendix	One per species	In seawater or preserved in 90% ethyl or isopropyl alcohol; refrigerate	Species dependent
	Quadrat or line transects	Algae, Eelgrass, Invertebrate Presence, Abundance and/or Coverage	Photo or voucher specimen; see Appendix 8	One per species per season	In seawater or preserved in 90% ethyl or isopropyl alcohol; refrigerate	Species dependent

Table 11.2. Typical Field Sampling Considerations

for common parameters (as may be contained in sampling SOPs)

Survey Type	Sample Type	Parameter(s)	Sampling Considerations
River water quality ▪ inland ▪ coastal ▪ misc.	In-situ (instrumentation)	▪ DO ▪ pH ▪ conductivity ▪ temperature ▪ other	Sample at consistent time each day – e.g. 10 AM – 1 PM window; however, DO best sampled in the very early morning (to capture "worst case" conditions after darkness) Inspection, maintenance, pre-calibration and post-checking of probes are critical to achieving accurate and precise measurements, especially for DO
	▪ Manual grab sample ▪ "Basket" sample ▪ Van Dorn sample ▪ Niskin sample	▪ TKN ▪ TN ▪ TP ▪ NH3-N ▪ NO3-NO2-N	Triple-rinse container in ambient water immediately prior to sample collection. Care must be taken to avoid contact between fingers and inside surfaces of containers, including bottle caps. New, pre-washed bottles preferred; if not, containers for nutrient samples should be acid-washed and rinsed with deionized water field filtration preferred for dissolved fractions
		▪ Fecal coliform ▪ *E. coli* bacteria ▪ Enterococci bacteria ▪ other "micro" samples	Sterile (new-sealed or autoclaved-sealed) bottle required. Place upright, capped sample bottle under the surface of the water about six inches. Do not rinse bottle. Slowly uncap and let it fill to capacity under the water. With hands away from the bottle opening, bring the bottle up and out of the water, pour sufficient water to leave approximately 1/2 inch air space in the bottle. Cap bottle and tighten. Latex gloves should be worn when sampling in waters suspected of contamination.
		TSS	Avoid disturbing bottom sediments. Leave one inch of air in container to allow shaking before analysis.
		Turbidity	Avoid disturbing bottom sediments. Leave one inch of air in container to allow shaking before analysis.
		Detergents (CHEMets kit)	If different analysts will generate data, make sure to perform inter-analyst comparisons using sample duplicates/splits. Using the absorbent pad/uv light method to detect optical brighteners may be more cost-effective, in light of cost of procuring refill reagents.
		Optical Brighteners/ Fluorescent Whitening Agents	Avoid exposure to sunlight.
		Pharmaceuticals and Personal Care Products (PPCPs), including caffeine	See note #2

Survey Type	Sample Type	Parameter(s)	Sampling Considerations
		DNA markers for human-specific strains of indicator bacteria	Special bottle prep for DNA marker analyses
	Cotton pad sampler	Optical Brighteners/ Fluorescent Whitening Agents	Avoid all direct contact with laundry soaps and detergents for at least 24 hours prior to handling any samplers. Wear disposable gloves when handling pads and sampling devices. Upon retrieval, place pads in *new* zip loc plastic bags.
	Refractometer Hydrometer	Salinity	Calibrate instrument to zero using distilled water before using
	Winkler bottle / reagent kit	Dissolved Oxygen (manual)	Sample collected at surface with care to avoid entraining bubbles into the bottle. If bubbles get in, empty and begin again. Sample is fixed immediately on site. Store in dark. Best sampled before sunrise to capture "worst case".
	Manual grab	pH, Alkalinity	Avoid stirring up bottom sediments. Collect sample under water surface. Fill to overflowing. Cap while under water to avoid air in sample.
	In-situ thermometer (manual)	Temperature	If collecting from depth (e.g. associated with DO sample), immediately place thermometer in sample water (but not in BOD bottle) upon retrieval from depth. Read within 30 seconds.
	In-situ	Flow	See note #5.
	Kick nets	Macroinvertebrates	When collecting from multiple areas (e.g. fast and slow sections, replicates) sample from furthest downstream location first; then work upstream. When brushing rocks/disturbing sediments, avoid sweeping specimens outside of flow entering net. When sampling streams with high flow fluctuations (e.g. below dams), avoid sites that are usually dry. Disturbed sites take 6-8 weeks to recolonize.
	Rain gage	Rainfall amount	Develop and follow an SOP
	GPS	Location by coordinates	Develop and follow an SOP
Lakes ▪ inland ▪ coastal	Manual grab sample Van Dorn sample	▪ TKN ▪ TN ▪ TP	See above for Rivers
	In-situ (instrumentation)	▪ DO ▪ pH ▪ conductivity ▪ temperature ▪ other	See above for Rivers

Survey Type	Sample Type	Parameter(s)	Sampling Considerations
	Secchi disk Viewscope Transparency tube	Secchi depth Transparency	Take readings between 10 am and 4 pm. Always sample from the shaded side of the boat and note whether a viewscope was used. Always sample without sunglasses. Note if disk hits bottom or is obscured by weeds. Note also when complete surface cover does not allow or complicates a reading. If surface obstruction can be temporarily cleared, take a reading.
	▪ Manual grab sample ▪ Van Dorn sample ▪ Depth-integrated tube	Chlorophyll a	Specify whether surface grab or depth-integrated. Take depth-integrated (tube) samples at depth 2X Secchi disk measurement.
	Manual grab	pH, Alkalinity	Avoid stirring up bottom sediments. Collect sample under water surface, fill to overflowing, cap while under water to avoid air in sample.
	Winkler bottle / reagent kit	Dissolved Oxygen (manual)	Sample collected 0.5m from bottom using Van Dorn or comparable collection device. Samples may also be collected at surface and at other depths to construct DO profile. Surface sample can be collected with BOD bottle only (no Van Dorn/other sampler), taking care to avoid bubbles. Best sampled in very early morning. Samples are fixed on site.
	Kick nets	Macroinvertebrates	See above for rivers
		Macrophytes	If possible, collect all parts of plant: roots, stems, leaves, flowers. Make sure all collections are labeled well so they are not mixed up
Beaches ▪ lakes ▪ rivers ▪ coastal	▪ Manual grab sample ▪ "Basket" sample ▪ Van Dorn sample	▪ Fecal coliform ▪ *E. coli* bacteria ▪ Enterococci bacteria	See above for Rivers
Coastal wetlands	Ditch or lift nets, bag seine, minnow traps	Nektons	Different equipment types and methods have different advantages and disadvantages (see Volunteer Handbook for Monitoring New England Salt Marshes). Creeks that are deep or have strong currents may be dangerous.
	In situ	Birds	Requires careful visual observations and keen auditory skills. Make sure at least one monitor is proficient with identifying birds by sight and birdcalls.
	In situ, quadrats	Vegetation	Depending on the size of the marsh, sampling may take four or more hours. Be prepared with proper clothing, water and food. Do not stay in the marsh if thunder and lightning are threatening.
	In situ	Tidal Hydrology	Take along a timer with an alarm so it can be set to remind monitors of each every 15-minute interval.
		Land Use	Mapping may be done in the office, but it is necessary to field truth assessment.
	D-net, auger, quadrat	Macroinvertebrates	Understand the particular conditions of the marsh being sampled (i.e. tide, thick mud, current) in regards to monitors' safety. Be prepared and careful.

Survey Type	Sample Type	Parameter(s)	Sampling Considerations
Harbors, bays, coves, etc. (saline)	Inventory survey	Algae, Invertebrate Presence	Begin at the low tide line so that the entire area is searched before covered by the incoming tide.
	Quadrat or line transects	Algae, Eelgrass, Invertebrate Presence, Abundance and/or Coverage	For algae and invertebrates, quadrats are randomly placed at low tide within the evaluation area. Begin in quadrants closest to the low tide line. For eelgrass surveys it may be necessary to start at the shallow water or deep water edge and work with the ebbing or flooding tide, respectively. Line transects on floating docks are not tide dependent. For dock surveys, take something to lie on to conduct search. Do not remove specimens from the transect area.

1) See Appendix 2 for references to selected field methods (as examples)

2) Coordinate with lab regarding sample volume requirements and other issues

3) The use of buckets to collect samples is not advised, due to the potential for sample contamination. Direct sample collection (i.e., water into sample bottle) is best

4) The use of Van Dorn bottle samplers may introduce contamination of low level phosphorus samples. Wash with P-free soap, DI rinse prior to use and evaluate risk by taking field equipment blanks

5) Due to the complexities involved in accurately estimating streamflow, streamflow measurements using velocimeters should only be performed by experts. Staff gage readings (that are incorporated into a site-specific stage-discharge curve developed by experts) are more appropriate for volunteer groups. Streamflow measurement for educational purposes is appropriate.

12. Sample Handling and Custody Requirements

□ General QAPP Requirement #12: The procedures used to label, transport, store and track custody of samples must be explained in the project *General QAPP Adoption Form*.

Sample handling and custody procedures shall be in compliance with project Standard Operating Procedures (SOPs).

Sample container labels can be attached to dry bottles, with the following information: Site ID#, sample type, date and time, preservation (if any), name of sampler, name of organization conducting sample. Macroinvertebrate and macrophyte samples may be labeled in pencil on paper placed in sample container or the samples may be placed in ziplock bags and label the outside with permanent ink markers. Examples of labels are found in Appendix 9. Specific steps shall be taken to avoid sample mis-labeling.

All samples shall be handled and transported in accordance with SOPs for each indicator. A summary of these steps is included in Table 11.1. **Chain of custody forms** shall be prepared and completed in all cases. The whereabouts of all samples shall be known at all times.

13. Analytical Methods Requirements

□ General QAPP Requirement #13: All analytical methods used in the project shall be identified in the *General QAPP Adoption Form* and be based on standardized laboratory methods that are specifically referenced or contained in the project-specific *General QAPP Adoption Form*.

The *General QAPP Adoption Form* shall include Standard Operating Procedures (SOPs) written by the laboratory for all methods used. These SOPs may reference a published method (e.g. SM 4500 P), but citing a method alone is not sufficient.

Table 13.1. Typical Analytical Methods (applicable for fresh and salt water, unless otherwise stated)

Parameter	Method #	Source of Method	Typical MDL (mg/l or as stated)	Alternative Applications Special Provisions "Kit" availability
Total Kjeldahl Nitrogen (TKN)	EPA 351 (.1, .2, .3 or .4)	EPA	0.05	
	SM 4500-N_{org} B SM 4500-N_{org} C	Standard Methods, 21st	0.05	
Total Nitrogen (TN)	SM 4500-N B SM 4500-N C	Standard Methods, 21st	0.05	
	WRIR 03-4174	USGS	0.05	
Ammonia (NH_3)	EPA 350 (.1, .2 or .3)	EPA	0.02	When the samples to be analyzed are saline waters, Substitute Ocean Water (SOW) should be used for preparing the standards; otherwise, distilled water is used.
	SM 4500-NH3	Standard Methods, 21st	0.02	
Nitrate-Nitrite-Nitrogen (NO_3-NO_2-N)	SM 4500-NO3 E-I)	Standard Methods, 21st	0.02	
	EPA 353 (.1, .2 or .3)	EPA	0.02	When the samples to be analyzed are saline waters, Substitute Ocean Water (SOW) should be used for preparing the standards; otherwise, distilled water is used.
Total Phosphorus (TP) (inc. P fractions, such as total reactive P, dissolved reactive P, total dissolved P, etc.)	SM 4500-P	Standard Methods, 21st	0.01	field filtration preferred for dissolved fractions
	EPA 365 (.1, .2 or .3)	EPA	0.01	
	SM 9222-D	Standard Methods, 21st	*lower reporting limit <10	

Parameter	Method #	Source of Method	Typical MDL (mg/l or as stated)	Alternative Applications Special Provisions "Kit" availability
Fecal coliform	SM 9221 (C, E)	Standard Methods, 21st	* lower reporting limit <10	
E. coli	EPA 1603 (Modified m-TEC)	EPA	* lower reporting limit <10	preferred indicator for fresh waters
	SM 9213-D (MTEC)	Standard Methods, 21st	* lower reporting limit <10	
	SM 9223-B (enzyme substrate)	Standard Methods, 21st	1 MPN/100 mls.	
Enterococci bacteria	EPA 1600 (MF)	EPA	* lower reporting limit <10	preferred indicator for marine waters
	SM 9230	Standard Methods, 21st	* lower reporting limit <10	
	ASTM D6503-99 (enzyme substrate)	ASTM	1 MPN/100 mls.	
Chlorophyll *a*	SM 10200 H	Standard Methods, 21st	1 ug/l	
Turbidity	EPA 180.1 or SM 2130-B	EPA or SM, 21st	0.2 NTU	
TSS	SM 2540D or EPA 160.2	EPA or SM, 21st	1 mg/l	
pH	SM-4500-H	SM, 21st	0.1 SU	in-situ measurement preferred over lab analysis; if lab, fill bottle to top with no headspace
Alkalinity	SM 2320-B	SM, 21st	2 mg/l	
Hardness	SM 2340-B	SM, 21st	2 mg/l	
Chloride	SM-4500-Cl-(B)	SM, 21st	1 mg/l	
Conductivity	SM-2510-B	SM, 21st	1 micromho/cm	
Dissolved Oxygen	SM 4500-O	Standard Methods, 21st	0.5 mg/l	Ensure reagents are fresh and thiosulfate titrant is standardized prior to beginning titration; Beware of over-running colorimetric end-point
Optical Brighteners/ Fluorescent Whitening Agents	*	*	qualitative	
Optical Brighteners/ Fluorescent Whitening Agents	* (solid phase extraction & HPLC)	*	variable (<0.5 ug/l preferred for all FWAs)	

Parameter	Method #	Source of Method	Typical MDL (mg/l or as stated)	Alternative Applications Special Provisions "Kit" availability
Caffeine	* (solid phase extraction & GC/MS)	*	variable (<20 ng/l preferred)	
Pharmaceuticals and Personal Care Products (PPCPs)	* (usually solid phase extraction & LC/MS)	*	variable (typically <5 ug/l for most chemicals)	
DNA markers for human-specific strains of indicator bacteria	* **	* **	---	

***** Lab-specific and/or research-based. See Appendix 3 for example lab method references.

** Library-based microbial source tracking (MST) methods have been intentionally left out of this general QAPP in favor of library-independent methods to determine likely source organisms for bacterial/pathogen pollution.

14. Quality Control Procedures

□ General QAPP Requirement #14: Project sampling shall include appropriate field and laboratory quality control samples to assess general data quality issues, as well as specific data quality objectives specified in Element 7 of the project *General QAPP Adoption Form*.

Coastal Water Quality

As a general rule, field quality control samples will be taken for 10% of all water quality samples taken. Example numbers of QC samples required to meet an approximately 10% rate are as follows:

- 1-10 samples taken, 1 QC sample is processed.
- 11-20 samples taken, 1-2 QC samples are processed.
- 21-30 samples taken, 2-3 QC samples are processed.

Specific procedures for taking ambient field blank QC samples and field duplicate QC samples shall be stated in the *General QAPP Adoption Form*.

Field duplicates can be 1) side-by-side and simultaneous, 2) sequential, or 3) split from a large volume sample.

For most analyses, **field blanks** (transferred from one container to another in the field) are generally preferred over trip blanks (blank samples simply taken on the survey trip and returned unopened).

To the extent possible, **inter-group comparison sampling** employing side-by-side sampling by two or more groups is also recommended. Any plans for this should be stated in the *General QAPP Adoption Form*.

Lab QC protocols shall be discussed with the lab prior to sampling to ensure acceptability.

Biological Monitoring

Quality control for **biological-type samples and measurements** shall also be discussed and defined prior to sampling (e.g., during training). This may involve duplicate field measurements by two different samplers, peer-review or expert-review of voucher identifications, photo documentation, etc.

Table 14.1. Typical Quality Control Measures

Sample Type	Instrument/ Parameter	Accuracy Checks	Precision Checks	% Field QC Samples (blanks and field duplicates)
Multiprobe instruments	All types	Pre-survey calibration and post-survey checks, including "zero" DO standard check	3-5 minutes of stable readings logged or recorded	verify repeatability in the field
Single probe instruments	Dissolved Oxygen	Compare with audit samples or Winkler titration method	Field duplicates	10%
	Salinity - Refractometer Hydrometer	External standards, freshwater – 0 salinity	Field duplicates	10%
	pH, alkalinity	Blind audit samples	Field duplicates	10%
	Turbidity	Field/lab blanks, formazin standards	Field duplicates	10%
	Conductivity	Field blanks, QC standard	Field duplicates	10%
	Thermometer	Compare with certified thermometer	Field Duplicates	10%
Water Quality samples – grab	TP, P fractions TN TKN NH3-N NO3-NO2-N	Field: blanks Lab: analysis of lab-fortified matrix (spiked samples) and/or lab QC standard	Field duplicates Lab duplicates	10%
	Fecal coliform *E. coli* Enterococci	Negative and positive plates	Field duplicates Lab duplicates	10%
	TSS Turbidity	External audit/QC standard, distilled water lab blank.	Field duplicates Lab duplicates	10%
	PPCPs (inc. caffeine)	Field: blanks Lab: analysis of lab-fortified matrix (spiked samples) and/or lab QC standard	Field duplicates Lab duplicates	10%
	DNA markers for human-specific strains of indicator bacteria	Blind audit samples from different animals	blind audit samples from different animals	min. once per project
	Dissolved Oxygen	Compare with blind QC standards (preferred) or known QC or calibration standards	Field Duplicates	10%
	Chlorophyll	Commercial audit samples	Field Duplicates	10%

Sample Type	Instrument/ Parameter	Accuracy Checks	Precision Checks	% Field QC Samples (blanks and field duplicates)
Physical/visual, etc.	Secchi disk Transparency tube	Annual calibration check of calibrated line	Field replicates (1-2 analysts)	100%
Physical/visual	Optical Brighteners/ Fluorescent Whitening Agents	Blank pads	Field replicates	10%
Physical/visual	Habitat assessments	NA	Different personnel conduct side-by-side assessments, compare	10%
Physical/visual	Aquatic plants	2 personnel conduct separate mappings of same area, compare results, discuss to resolve differences. 2 personnel ID plants separately. Discrepancies/unknowns taken to expert for ID confirmation.		10%
Physical/visual	Benthic Macroinvertebrates	IDs verified by external expert. 90% Accuracy of identification when Invertebrate Scientific Advisor examines a minimum of 10% of the original samples		10%
Physical/visual	Nektons	100% Accuracy of identification evaluated by the Scientific Advisor(s)		
Physical/visual	Birds	100% Accuracy of identification evaluated by the Scientific Advisor(s)		
Physical/visual	Vegetation	100% Accuracy of identification evaluated by the Scientific Advisor(s)		
Physical/visual	Tidal Hydrology		Different personnel conduct side-by-side measurement readings, compare	
Physical/visual	Land Use		Different personnel conduct side-by-side assessment, compare	
Inventory, quadrat and line transects	Algae, Eelgrass, Invertebrates	100% Accuracy to genus or species; taxonomic verification of voucher specimens by Scientific Advisor(s).		

15. Instrument/Equipment Inspection and Testing

□ General QAPP Requirement #15: The project shall include a systematic process for consistently checking, testing and maintaining instruments and equipment for proper functioning.

Maintenance shall occur as needed. Records of equipment inspection, maintenance, repair and replacement shall be kept in a logbook. In addition to following a manufacturer's recommendations, group-specific SOPs for instrument maintenance and calibration shall be developed and followed.

Table 15.1. Typical Instrument/Equipment Inspection, Testing Procedures

Equipment Type	Inspection Frequency	Type Inspection	Maintenance, Corrective Action
Nutrient Sample bottles	Before each use	Visual for integrity, cleanliness.	Acid washed prior to delivery to volunteers
Filtering apparatus (dissolved phosphorus)	Before each use	Proper functioning, clean storage	Spare syringe, spare filters
Filtering apparatus (chlorophyll)	Before each use	Proper functioning, clean storage	Spare filters
Secchi disk, calibrated line	Before each use	Visual for integrity, cleanliness.	Wipe tape after each use. Spare disk, spare line
Autoclave (bacteria analysis)	Weekly	Spore check is run with a batch to ensure the autoclave is reaching proper temperature and pressure	
Sample prep equipment (e.g., sealer for Collier® bacteria method)	Prior to each sampling	Visual inspection, clean, and maintain according to manufacturer's recommendations.	Spare sampler
Incubator (bacteria analysis)	Prior to each sampling	Check temperature with max/min electronic thermometer (traceable to NIST)	Spare batteries, electrolyte
pH Meter	Before each sampling date	Battery life, level of electrolyte, integrity of probe	Spare batteries, electrolyte

Equipment Type	Inspection Frequency	Type Inspection	Maintenance, Corrective Action
Thermometer	Before each sampling date	Visual, breakage/ integrity of column.	Keep spares on hand.
DO / other Water Quality Meter	Before each sampling date	Battery life, electrical connections, membrane condition	Spare membranes, batteries
Flow meter	Before each use	Spin test re. Office of Surface Water Technical Memorandum 99.06	Clean after each use. See Tech Memo 99.06
Digital Titrate	Before each sampling date	Proper installation of cartridge, zero reset	Spare cartridges, dispensing tubes
Van Dorn, other sampling device	Before each sampling run	Visual for integrity	Repair, replace as necessary
Electronic balance (solids)	Before each sampling run	Visual - integrity of balance.	N/A
Conductivity meter	Before each sampling date	Battery life	Spare batteries
Turbidity meter	Before each sampling date	Battery life	Spare batteries
Collection rake, rope	Before each collection	Visually for integrity	Repair, replace. Keep spares on hand
Macroinvertebrate kick nets, buckets, sieves	Before each collection	Visually for integrity	Repair, replace. Keep spares on hand
Refractometer	Before each use	Visually for integrity	Keep clean, replace as necessary

16. Instrumentation Calibration and Frequency

□ General QAPP Requirement #16: All instruments used in the project shall be calibrated at a pre-determined frequency to ensure instrument accuracy and precision for the duration of the project (with logbook documentation).

Table 16.1. Typical Instrumentation Calibration Procedures

Instrument	Inspection and Calibration Frequency	Standard of Calibration Instrument Used	Corrective Action
Calibrated line	Annually	Tape Measure	Recalibrate or replace with calibrated line
Multi-probe meter	Before each sampling run	Standard solutions, according to manufacturer's recommendations	According to manufacturer's instruction.
pH Meter	Before each sampling run	pH buffers 4.01 and 7 or external standards	Adjust instrument, clean electrodes, replace electrodes
Thermometer	Annually	NIST certified thermometer	Replace or provide correction factor
DO / other Water Quality Meter	Before each sampling run	Follow manufacturer's instruction. DO meter: compare against Winkler titration	Replace membrane or correct instrument
Electronic balance (solids)	Before each sampling run	Use of certified inspection standards	Adjust and recalibrate
Conductivity meter	Before each sampling run	Known Standards	Adjust according to manufacturer's recommendations
Turbidity meter	Before each sampling run	External standards	Adjust instrument
Flow meter	Before each sampling run	NA	According to manufacturer's instruction. Also see Office of Surface Water Tech. Memo 99.06
Refractometer	Before each sampling run	Fresh water, 0 Salinity	Recalibrate, replace, repair as needed

* External standards refer to standards of reliable quality obtained from reputable commercial or other supplier. Known standards refer to those where the value is known before calibration.

17. Inspection & Acceptance Requirements for Supplies

□ General QAPP Requirement #17: The procurement, inspection, and acceptance of sampling, analytical, and ancillary project supplies shall occur in a consistent and timely manner.

Table 17.1. Typical Supplies Inspection, Acceptance Procedures

Supplies	Inspection Frequency	Type of Inspection	Available Parts	Maintenance
Reagents, titration cartridges, alcohol	Before each sampling date	Visual inspection of quantity and expiration date	Spare, fresh reagents/cartridges	Storage according to manufacturer's recommendations, Annual replacement at beginning of sampling season
Calibration Standards	Before each sampling date	Visual inspection of quantity and expiration date	Spare, fresh solutions	
Membranes, filters, bags (e.g. Whirlpak, zip lock)	Before each sampling date	Visual inspection of quantity, integrity	Spares	Storage according to manufacturer's recommendations
Field and Lab sample sheets	Before each sampling date	Visual	Additional copies	
Waders or Life Preservers	Before each sampling date	Visual inspection for damage	Patch kit	As needed
Sample Bottles	Before each sampling date	Integrity, cleanness and seal for nutrient bottles, verified sterility of bacterial sample bottles, equipment or reinstate blank for reused bottles (see Glossary)	One set of spare bottles	Clean after use
Cooler	Before each sampling date	Cleanness, Ice packs		Annually or as needed

18. Data Acquisition Requirements

□ General QAPP Requirement #18: The *General QAPP Adoption Form* shall provide detailed information for any non-project data used in developing and implementing the *General QAPP Adoption Form* or in any other way affecting the project.

To verify that any data used by this project but not collected by project personnel are of known and documented quality and are consistent with project data quality objectives, the following "metadata" will be provided for each data source ("metadata" are defined as the important information associated with sample data; examples include sampling location, date, time, type of sample, etc.):

- Title of document or descriptive name of the information
- Source of information
- Notes on quality of data, including whether it has a QAPP or some other means of demonstrating quality of the data
- As applicable, a statement on planned restrictions in use of the data because of questions about data quality.

Specific information regarding non-project data shall be provided in the project *General QAPP Adoption Form*.

19. Data Management

□ General QAPP Requirement #19: As detailed in the *General QAPP Adoption Form*, the project shall include a data management system.

Field samplers shall record data on field sheets, review them, sign, and turn them over to the field coordinator. The Field Coordinator will review the sheets and confer with samplers on any needed corrective action. Field samplers will fill out the chain-of-custody form for forwarding the processed samples to the laboratory. Each person who handles or transports samples will also sign the custody form upon receipt of the samples. Chain of custody forms will follow samples to the lab and back to the Monitoring Coordinator by mail or pickup after each analysis run is completed.

Once laboratory analyses are complete, the laboratory personnel will mail lab results to the Monitoring Coordinator or arrange for pickup. The Monitoring Coordinator and/or Data Entry Coordinator will enter raw field and lab data into the project computer system. Computer-entered data are then compared with field sheets for accuracy. The original data sheets will be stored in the organization's office. Disk back-ups and copies of the data sheets will be made and stored in a separate location designated by the Monitoring Coordinator.

Data quality control steps will be taken at several stages, as outlined in Table 19.1. Documentation of data recording and handling, including all problems and corrective actions, shall be included in all preliminary and final reports.

Digital water quality, salt marsh, and introduced species data will be entered into a data entry template provided by CZM or in a format that is compatible with CZM data management systems. Digital data management tools available (upon request) from CZM include

- The CZM Water Quality Tool Pack: accepts water quality data collected at individual sample locations
- Marsh M.D: accepts salt marsh data collected using Massachusetts Wetland Restoration Program protocols
- The Marine Invader Database: accepts spatially reference marine introduced species occurrence data.

The project *General QAPP Adoption Form* shall describe any additional program-specific data management systems - e.g. spreadsheets, databases (preferably compatible with Microsoft Excel and Access), statistical or graphical software packages, location of data records (paper and electronic), and examples of forms and checklists.

Table 19.1. Data Management, Review, Validation, Verification Process

Activity	By whom	Corrective action, if needed
Check labels just prior to sampling, to ensure correct labeling of container.	Field sampler	Correct label or change container
At time of sampling, record data, sign field sheets.	Field sampler	
Fill out, sign chain of custody (COC) forms for any samples going to lab.	Field sampler	
Before turning field sheets over to field/monitoring coordinator, check for reasonableness to expected range, completeness.	Field sampler	Resample if feasible; otherwise, flag suspect data.
Upon receipt of field sheets, recheck for reasonableness to expected range, completeness, accuracy, and legibility. Sign COC form.	Field/Monitoring Coordinator	Confer with field sampler(s) immediately or within 24 hours. Resample if feasible; otherwise, flag suspect data.
Upon receipt of samples, field sheets and COC forms, check to see that sheets and forms correspond to number of samples, condition of samples as stated on COC forms. Sign COC forms. Copies of field sheets and COC forms are made, given to field/monitoring coordinator.	Lab Coordinator, Field/Monitoring Coordinator.	Confer with field/monitoring coordinator. Contact field samplers as needed to locate missing samples, data records. In case of missing/spoiled samples or data records, authorize resembling as needed and feasible. If resampling is not feasible, flag all suspect data.
Upon completion of laboratory analyses, fill out lab sheets, including data on QC tests. Review for reasonableness to expected range, completeness. Make copies of lab sheets.	Lab Coordinator.	Re-analyze if possible. If not, confer with monitoring coordinator. Flag all suspect data.
Upon receipt of lab sheets, review for completeness and legibility.	Monitoring/Data Entry Coordinator.	Confer with lab coordinator.
Upon completion of data entry, print out raw data. Compare with field/lab sheets for accuracy.	Data Entry Coordinator or other volunteer. Data entry personnel may review their own work, but a different person than data entry person shall perform the final accuracy comparison.	Re-enter data.

Activity	By whom	Corrective action, if needed
Translate raw data printouts into preliminary data reports: run statistical analyses and/or prepare graphical summaries of data. Check for agreement with QC objectives stated in Tables 7.1. and 14.1. and for completeness.	Monitoring Coordinator/Data Entry Coordinator	Confer with QA Officer. Flag or discard suspect data.
In-season (at least once) and end of season review of collected data sets (individual sample runs and season-total compilations); review for completeness and agreement with QC objectives and DQOs.	Monitoring Coordinator. TAC if applicable. Share with QA Officer.	Flag or discard suspect data. Decide upon any restrictions in use of data with respect to original data use goals.

20. Assessment and Response Actions

□ General QAPP Requirement #20: The project shall have a defined process for identifying and effectively addressing issues that affect data quality, personal safety, and other important project components.

The progress and quality of the monitoring program shall be continuously assessed to ensure that its objectives are being accomplished. The Monitoring Coordinator will periodically check to see the following:

a. Monitoring is occurring as planned;
b. Sufficient written commentary and supporting photographs exist;
c. Sufficient volunteers are available;
d. Volunteers have been observed as they sample their sites;
e. Samplers are collecting in accordance with project schedules;
f. Data sheets and custody control sheets are being properly completed and signed;
g. Data are properly interpreted;
h. Plans for dealing with adverse weather are in place;
i. Retraining or other corrective action is implemented at the first hint of non compliance with the QAPP or SOPs;
j. Labs are adhering to the requirements of their QAPP, in terms of work performed, accuracy, acceptable holding times, timely and understandable results and delivery process;
k. Data management is being handled properly, i.e. data are entered on a timely basis, is properly backed up, is easily accessed, and raw data are properly stored in a safe place;
l. Procedure for developing and reporting the results exists.

The Monitoring Coordinator shall confer with the QA Officer as necessary to discuss any problems that occur and what corrective actions are needed to maintain program integrity. In addition, the Monitoring Coordinator and QA Officer shall meet at the end of the sampling season, to review the draft report and discuss all aspects of the program and identify necessary program modifications for future sampling activities. If the program includes a technical advisory committee, the TAC shall be included in these discussions. Corrections may include retraining volunteers; rewriting sampling instructions; replacement of volunteers; alteration of sampling schedules, sites or methods; or other actions deemed necessary. All problems discovered and program modifications made shall be documented in the final version of the project report. If modifications require changes in the Quality Assurance Project Plan, these changes shall be submitted to CZM and/or DEP for review.

If data are found to be consistently outside the Measurement Quality Objectives, see Section 7, the Monitoring Coordinator and the TAC (as applicable) shall review the program and correct problems as needed.

21. Reports

□ General QAPP Requirement #21: The project shall include a reporting mechanism for project data. Reporting shall include raw data, QC data, and important metadata.

Data that have passed preliminary QC analysis as described in Table 19.1. may be posted on the organization's web site, shared with the local media or at other venues (e.g. kiosks at recreation access sites), and submitted to CZM and/or DEP. A caveat will accompany these or any data released on a preliminary basis, explaining that they are for review purposes only and subject to correction after completion of a full data review occurring at the end of the sampling season.

The Monitoring Coordinator will write a final report, with assistance from the QA Officer. This will be sent to the QAPP distribution list. The final report will include (updated as necessary) any tables and graphs that were developed for initial data distribution efforts (i.e. the web site and media), and it will describe the program's goals, methods, quality control results, data interpretation, and recommendations. This report may also be used in public presentations.

All reports, preliminary or final, will include discussion of steps taken to assure data quality, findings on data quality, and decisions made on use, censor, or flagging of questionable data. Any data that are censored in reports will be either referred to in this discussion, or presented but noted as censored.

Reports submitted to state and federal agencies shall conform to DEP guidelines CN 0.74 *Recommended Content of 3rd Party Data* and CN 0.78 *Data Deliverable Guidelines for Grant Projects* (see Appendix 4).

22. Data Review, Validation and Verification Requirements

□ General QAPP Requirement #22: All project data, metadata and quality control data shall be critically reviewed to look for problems that may compromise data usability.

The Monitoring Coordinator will review field and laboratory data after each sampling run and take corrective actions as described in Table 19.1. At least once during the season, at the end of the season and if questions arise, the Monitoring Coordinator will share the data with the QA Officer to determine if the data appear to meet the objectives of the QAPP. Together, they will decide on any actions to take if problems are found.

23. Validation and Verification Methods

□ General QAPP Requirement #23: The *General QAPP Adoption Form* shall explain how all project data and metadata are reviewed and approved as usable data (and as un-usable when the data are questionable for any reason).

Data validation and verification will occur as described in Table 19.1, and will include checks on:

- Completion of all fields on data sheets; missing data sheets
- Completeness of sampling runs (e.g. number of sites visited/samples taken vs. number proposed, were all parameters sampled/analyzed)
- Completeness of QC checks (e.g. number and type of QC checks performed vs. number/type proposed)
- Number of samples exceeding QC limits for accuracy and precision and how far limits were exceeded.

24. Reconciliation with Data Quality Objectives

□ General QAPP Requirement #24: The *General QAPP Adoption Form* shall describe a process (and mechanisms to accomplish it) whereby resulting data are compared to the planned DQOs in the project *General QAPP Adoption Form*.

At the conclusion of the sampling season, after all in-season quality control checks, assessment actions, validation and verification checks and corrective actions have been taken, the resulting data set will be compared with the program's data quality objectives (DQOs). This review will include, for each parameter, calculation of the following:

- Completeness goals: overall % of samples passing QC tests vs. number proposed in Section 7
- Percent of samples exceeding accuracy and precision limits
- Average departure from accuracy and precision targets.

After reviewing these calculations, and taking into consideration such factors as clusters of unacceptable data (e.g. whether certain parameters, sites, dates, volunteer teams etc. produced poor results), the Monitoring Coordinator, QA Officer, and TAC members (as applicable) will evaluate overall program attainment of DQOs and determine what limitations to place on the use of the data, or if a revision of the DQOs is allowable.

Appendices

Appendix 1: General Quality Assurance Project Plan Adoption Form

General Quality Assurance Project Plan Adoption Form For

Project:_____

1. Signature Page

We, the undersigned, have read and understand the requirements outlined in the General QAPP for Massachusetts Volunteer Coastal Monitoring, and establish that this project meets the overall intent and requirements set forth in the General QAPP.

Project Manager

_____

Name Date
Address
Phone: Fax: Email:

Monitoring Program Coordinator

_____

Name Date
Address
Phone: Fax: Email:

Program Quality Assurance Officer

_____

Name Date
Address
Phone: Fax: Email:

_____

Todd Callaghan, CZM Program Contact Date
251 Causeway St. Suite 900, Boston, MA 02114-2119
617- 626-1233 Fax: 617-626-1240 email: todd.callaghan@state.ma.us

_____

Richard Chase, DEP QA Officer Date
627 Main St., 2nd floor, Worcester, MA 01608
(508) 767-2859 Fax: 508-791-4131 email: richard.f.chase@state.ma.us

_____

Arthur Screpetis, DEP Technical Reviewer Date
627 Main Street, 2nd floor, Worcester, MA 01608
508-767-2875, Fax: 508-791-4131 email: arthur.screpetis@state.ma.us,

2. Table of Contents (must be revised upon completion of the *General QAPP Adoption Form*)

3. Distribution List (as applicable)

Project Manager: _____

Monitoring Program Coordinator: _____

Program Quality Assurance Officer: _____

Project Field Coordinator: _____

Project Lab Coordinator: _____

Data Management Coordinator: _____

Program Participants:

_____
_____
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_____

Richard Chase, DEP QA Officer
627 Main St., 2nd floor, Worcester, MA 01608
Phone: (508) 767-2859 Fax: 508-791-4131
email: richard.f.chase@state.ma.us

Arthur Screpetis, DEP Technical Reviewer
627 Main Street, 2nd floor, Worcester, MA 01608
Phone: 508-767-2875, Fax: 508-791-4131
email: arthur.screpetis@state.ma.us

Todd Callaghan, CZM Project Contact
251 Causeway St. Suite 800, Boston, MA 02114-2119
Phone 617- 626-1233 Fax: 617-626-1240
email: todd.callaghan@state.ma.us

Town/City Governance: _____

Conservation Commission: _____

Regional/Local Planning Office: _____

Other(s):

_____
_____
_____
_____
_____
_____
_____
_____
_____

4. Project Organization and Responsibilities (as applicable)

Table 4.1. Project Organization and Responsibilities

Name(s)	Project Title	Description of Responsibilities
	Project Manager	
	QA Officer	
	Monitoring Program Coordinator	
	Lab Coordinator	
	Field Coordinator	
	Data Management Coordinator	
	Technical Advisory Committee	

Name(s)	Project Title	Description of Responsibilities
see distribution list	Volunteers	
Todd Callaghan	Agency Project Contact	Oversees grant administration and ensures reporting requirements are met.
Richard Chase	DEP QA Officer	Reviews *General QAPP Adoption Form*, reads QA reports, confers with program QA officer on quality control issues that arise during the course of a monitoring program.
Arthur Screpetis	DEP Technical Reviewer	Reviews *General QAPP Adoption Form.*

5. Problem Definition/Background

Organizational History and Mission

A brief summary of your organization's history and general goals, why your organization is involved, and what it hopes to accomplish

Monitoring History and Status

A discussion of previous monitoring efforts and the designated use attainment status for water body(ies) as listed in the DEP health assessments

Monitoring and Data Use Objectives

As specified in the GENERAL QAPP, this project will provide information related to the following coastal issues *(check all that apply)*:

- ❑ Coastal Water Quality
- ❑ Wetland Health and Coastal Habitat Assessment
- ❑ Marine Introduced Species

As explained in the GENERAL QAPP, the monitoring objectives of this project include *(check all that apply)*:

- ❑ Provide quality-controlled data that support the assessment and restoration of coastal watersheds and critical habitats through the implementation of Commonwealth programs such as (*check all that apply*):
  - ❑ DEP's 305(b) water body health assessments and TMDL development for impaired waters
  - ❑ Clean Water Act Section 319 projects
  - ❑ Massachusetts Aquatic Invasive Species Management Plan
  - ❑ EOEA's watershed action plans
  - ❑ National Estuary Programs' Comprehensive Management Plans
  - ❑ CZM's Nonpoint Source Pollution Remediation Program
  - ❑ Commonwealth's Beaches Act
  - ❑ CZM's Wetlands Restoration Program
  - ❑ Other (specify) _____

- ❑ Leverage the Commonwealth's funds to increase the collection of quality data
- ❑ Water body/watershed health assessment
- ❑ Impact assessment
- ❑ Source identification or hot spot monitoring
- ❑ Marine introduced species assessments
- ❑ Public education and outreach
- ❑ Local infrastructure improvements
- ❑ Other (specify) _____

6. Project /Task Description

Project Description:

A general summary of the project, providing information regarding who does what, parameters to be monitored, when monitoring will occur, number of sites, what happens with the data, and how the data will support program objectives.

Map(s) of Area, Waterbody and Sampling Sites:

Include map(s) of area and pertinent water bodies with sampling site (here, in Element 10 or in an appendix).

Table 6.1. Anticipated Schedule ***(Mark all major project implementation and completion dates with an X. Add additional project components and deliverables as necessary.)***

Activity	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Kickoff meeting with project team												
Develop draft *General QAPP Adoption Form*												
Finalize *General QAPP Adoption Form*												
Meeting with agency representatives												
Equipment inventory, purchase, inspection and testing												
Field training and database-related training session(s)												
Meeting with analytical laboratory												
Lab training sessions (in-house analyses)												
Sampling surveys												
Data entry												
Data review and validation												
Field audit(s)												
Lab audit(s)												
Draft report												
Final report												
Data uploads to website												

7. Data Quality Objectives

To comply with the GENERAL QAPP, the following quality control measures and data quality objectives shall be employed for the _____ project *(check all that apply)*:

<u>Overall sampling precision</u> will be estimated by the following *(check all that apply)*:

- ❑ Taking duplicate field measurements (instruments) for at least 10% of samples.
- ❑ Taking duplicate field samples for at least 10% of samples (for each crew).
- ❑ Lab duplicates
- ❑ Comparison to results of others (for same/similar area/time)
- ❑ Other (*specify):* _____

<u>Accuracy of results</u> will be estimated or confirmed by the following *(check all that apply)*:

- ❑ Analysis of lab QC check samples (single-blind)
- ❑ Analysis of positive/negative controls (e.g., bacteria)
- ❑ Analysis of spiked matrix samples
- ❑ Analysis of lab blanks and lab-fortified blanks
- ❑ Taking ambient field blanks and/or equipment blanks
- ❑ Taxonomic verification of voucher specimens
- ❑ Other *(specify):* _____

<u>Data Representativeness</u> will be met by the following *(check all that apply)*:

- ❑ All sampling sites are selected to be representative of "average" conditions for the water body (or pollution source) at a specific place and time
- ❑ Any abnormal or episodic conditions that may affect the representativeness of sample data are noted and maintained as metadata
- ❑ Results from all sites will not be extrapolated to other, unmonitored, portions of the waterbody or watershed.
- ❑ Sample collection timing and frequency is selected to capture data that are representative of target conditions: (*e.g. wet weather, ebb tide, etc...)*
- ❑ Other *(specify)*_____

<u>Comparability of project data</u> among sites and with that of others will be enhanced by the following *(check all that apply)*:

- ❑ Using established protocols
- ❑ Documenting methods, analysis, sampling sites, times and dates, sample storage and transfer, as well as laboratories and identification specialists used so that future surveys can produce comparable data by following similar procedures.
- ❑ Other *(specify)*_____

<u>Data Completeness</u> goals shall be *(check all that apply)*:

- ❑ At least 80% of the anticipated number of samples will be collected, analyzed and used
- ❑ Tracked by keeping detailed and complete sample and survey records
- ❑ Summarized via a report detailing number of anticipated samples, number of valid results, and percent completion for each parameter
- ❑ Other (*specify*) _____

Table 7.1. Data Quality Objectives *(as appropriate)*

Parameter	Units	MDL	RDL	Expected Range	Accuracy (+/-)	Precision (RPD)
Example: Total Kjeldahl Nitrogen	mg/l	0.05	0.05	0-2	80% - 120% recovery of lab fortified matrix (LFM)	30%

MDL = Method Detection Limit (lab)
RDL = Reporting Detection Limit (lab)

8. Training Requirements

Training in the following general areas, as specified in the General QAPP, shall be conducted as part of the _____ (*program/project name)*:

- ❑ Field safety
- ❑ Lab safety
- ❑ Water sample collection
- ❑ Filling out field sheets
- ❑ Biomonitoring of wetlands and coastal habitat
  (*specify parameters)*_____
- ❑ Marine introduced species monitoring
- ❑ Data entry and database management
- ❑ Recordkeeping and documentation
- ❑ Report writing
- ❑ Other: (*specify)*_____

Project training shall take place as specified in Table 8.1

All training activities shall be documented by *(check all that apply)*:

- ❑ Training forms signed by the trainees
- ❑ Documented in a final report
- ❑ Other *(specify)*:
  _____

Table 8.1. Project-Specific Training

Training: Type & Description	Trainer(s)	Training Date(s)	Trainees	Location of Training Records
Example: Secchi, tidal elevation, precipitation monitoring, TKN sampling.	Monitoring Coordinator.	At beginning of project and whenever new volunteers join.	Volunteers *to be named*	Watershed Organization computer (electronic copy), office filing cabinet #1 (paper copy)

Training: Type & Description	Trainer(s)	Training Date(s)	Trainees	Location of Training Records

9. Documentation and Records

To ensure that an adequate and acceptable level of records are kept, the following general documentation procedures, as specified in the General QAPP, shall be followed *(check all that apply)*:

- ❑ Document survey and sample information using Field Sheets
- ❑ Document survey and sample information using personal Field Notebooks
- ❑ Document sample custody at all times using Chain-of-Custody Forms
- ❑ Track sample identification using sample labels
- ❑ Document lab data/metadata using lab notebooks
- ❑ Document lab results using lab reports
- ❑ Collection and management of voucher specimens
- ❑ Photography used for species verification
- ❑ Other: (*specify)*_____

The specific forms to be used for the _____ project are listed and described in Table 9.1.

Table 9.1. Project-Specific Datasheets, Labels, Laboratory and Voucher Forms

Documentation Type	Form Name	How Used?	Example in Appendix?
Sample Collection Records			
Field Analysis Records			
Laboratory Records			
Data Assessment Records			
Training Records			

10. Sampling Process

To comply with the General QAPP, the following sampling safety and design principles shall be followed for the _____ project *(check all that apply)*:

Sampling Safety.

- ❑ Personal safety shall be a primary consideration in selection of sampling sites and dates.
- ❑ No sampling shall occur when personal safety is thought to be compromised.
- ❑ The Monitoring Coordinator and Field Coordinator shall confer before each sampling event to decide whether conditions pose a threat to safety of field volunteers, and will cancel/postpone sampling when necessary.
- ❑ Sampling shall take place in teams of two or more.
- ❑ Samplers shall wear life vests when sampling from boats or wading in waters under difficult conditions.
- ❑ Samplers shall wear proper clothing to protect against the elements as applicable, especially footwear and raingear.
- ❑ When sampling in rivers, samplers shall estimate flow and avoid sampling when river depth (in feet) times velocity (feet per second) appear to equal 5 or greater.
- ❑ Other safety measures:_____

Table 10.1. Sampling Design The following sampling considerations will be adhered to. *(fill in for each assessment type)*

Survey type	Indicators	Number of sample locations	**Site location rationale**	**Frequency, duration, special conditions**	**Field survey QC**
_____ Assessment Type					

11. Sampling Method Requirements

To comply with the requirements of the General QAPP, all sample collections for the _____project shall follow detailed methods on how samples will be collected and preserved and/or follow the Standard Operating Procedures (SOPs) contained in Appendix A.

- ❑ Detailed sampling method descriptions are in Appendix A.
- ❑ Copies of standard operating procedures (SOPs) are in Appendix A.
- ❑ Pre-coordination will occur with project lab(s) to ensure that sample collection procedures meet lab needs. *List labs:*
  _____
  _____

Table 11.1. Sample Collection Methods *Fill in*

Survey type	Sample Type	Parameter(s)	**Container Type(s) and Preparation**	**Minimum Sample Quantity**	**Sample Preservation**
_____ Assessment Type					

12. Sample Handling and Custody Requirements

As specified in the General QAPP, all sample handling and custody procedures shall be in compliance with project Standard Operating Procedures for each indicator. The following procedures shall be followed for the _____project. *(Check all that apply).*

- ❑ Sample container labels shall be attached to dry bottles, with the following information:
  - ❑ Site ID# □ sample type
  - ❑ date and time □ preservation
  - ❑ name of sampler
  - ❑ name of organization conducting sample.

- ❑ Macroinvertebrate □ macrophyte
  - ❑ samples shall be labeled in pencil on paper placed in sample container

OR

- ❑ Macroinvertebrate □ macrophyte
  - ❑ samples shall be placed in ziplock bags; outside of bags shall be labeled with permanent ink markers.

- ❑ Examples of labels are found in the General QAPP Appendix 9.
- ❑ Chain of custody forms shall be prepared and completed in all cases.
- ❑ The whereabouts of all samples shall be known at all times.

The following steps shall be taken to avoid sample mis-labeling.

13. Analytical Methods Requirements

To comply with the requirements of the General QAPP, all analytical methods used in the _____project, including methods used by laboratories performing analyses for the project, shall be based on standardized laboratory methods.

All analytical methods used for this project are should be provided in Attachment B.

Table 13.1. Analytical Methods The following methods are used in this project.

Parameter	Method #	Source of Method	MDL (mg/l or as stated)	Alternative Applications Special Provisions "Kit" availability
Example: Total Kjeldahl Nitrogen (TKN)	EPA 351.3 , with EBL procedures specified in SOP, Attachment B.	EPA, modified by EBL laboratory personnel	0.1	None

14. Quality Control Procedures

As specified in the General QAPP, the following quality control procedures for the _____project shall be followed *(Check all that apply)*

Coastal Water Quality

- ❑ Field duplicates shall be taken side-by-side and simultaneous
- ❑ Field quality control samples shall be taken for 10% of all water quality samples collected unless otherwise specified in Table 14.1 below
- ❑ Field duplicates shall be taken sequentially
- ❑ Field duplicates shall be split from a large volume sample.
- ❑ Field blanks shall be taken
- ❑ Trip blanks shall be taken

Procedures for each QC step checked above are described here:

- ❑ Inter-group comparison sampling shall be conducted. Comparison sampling methods are as follows:

- ❑ Lab QC protocols shall be discussed with the lab(s) prior to sampling to ensure acceptability

Wetland Health and Coastal Habitat Assessment or Marine Introduced Species

Biological samples and measurements shall include *(check all that apply)*:

- ❑ Field measurements by two different samplers
- ❑ Duplicate measurement by same sampler
- ❑ Compare side-by-side assessment/identification made by two or more personnel
- ❑ Compare to a voucher specimen collection
- ❑ Peer-review of voucher identifications
- ❑ Two or more personnel conduct separate mappings of same area, compare results, discuss to resolve differences
- ❑ Discrepancies/unknowns taken to expert for ID confirmation.
- ❑ Verification in the field of an organism identity by an expert or qualified supervisor
- ❑ Taxonomic verification of voucher specimens by scientific advisor(s).
- ❑ Photo documentation
- ❑ Other *(provide description of QC measures for all boxes checked):*

Procedures for each QC step checked above are described here:

- ❑ Inter-group comparison sampling shall be conducted. Comparison sampling methods are as follows:

Table 14.1. Quality Control Procedures for each survey type, instrument/parameter are summarize here:

Sample Type	Instrument/ Parameter	Accuracy Checks	Precision Checks	% Field QC Samples (blanks and field duplicates)

15. Instrument/Equipment Inspection and Testing

To comply with the requirements of the General QAPP, the following instrument/equipment inspection and testing methods shall be followed for the _____project. *(Check all that apply, fill in Table 15.1 as needed)*

- ❑ Maintenance shall occur as needed.
- ❑ Records of equipment inspection, maintenance, repair and replacement shall be kept in a logbook.
- ❑ Detailed inspection, maintenance and calibration procedures are described in SOPs contained in Appendices A and B.

Table 15.1. Instrument/Equipment Inspection, Testing Procedures – Summary

Equipment Type	Inspection Frequency	Type Inspection	Maintenance, Corrective Action
Example: TKN sample bottles	Before each use	Visual for integrity, cleanliness	Acid washed prior to delivery to volunteers

16. Instrumentation Calibration and Frequency

To meet the requirements of the General QAPP, the following instrument calibration procedures will be followed for the _____ project:

- Instruments shall be calibrated at the frequency listed in table 16.1
- Detailed inspection, maintenance and calibration procedures are described in SOPs contained in appendices A and B.
- All calibration activities shall be logged in a project notebook

Table 16.1. Instrumentation Calibration Procedures

Instrument	Inspection and Calibration Frequency	Standard of Calibration Instrument Used	Corrective Action
Example: pH Meter	Before each sampling run	pH buffers 4 and 7 or external standards	Adjust instrument, clean electrodes, replace electrodes

17. Inspection & Acceptance Requirements for Supplies

To meet the requirements of the General QAPP, the following procedures for procurement, inspection and acceptance of sampling, analytical and ancillary project supplies shall be followed for the _____ project:

Table 17.1. Supplies Inspection, Acceptance Procedures

Supplies	Inspection Frequency	Type of Inspection	Available Parts	Maintenance
Example: Reagents, titration cartridges	Before each sampling date	Visual inspection of quantity and expiration date	Spare, fresh reagents/cartridges	Storage according to manufacturer's recommendations, Annual replacement at beginning of sampling season

18. Data Acquisition Requirements

To meet the data acquisition requirements of the General QAPP, the following information will be provided for the _____ project *(check all that apply):*

- ❑ No data other than that collected by project participants under the auspices of this *General QAPP Adoption Form* will be used.
- ❑ External data validity shall be documented as described in Table 18.1

Table 18.1. Non-Project Data Validity The following data will be used. Data validity is described here: (*fill in)*

Title or descriptive name of data document	**Source of data**	**QAPP written? Y/N**	**Notes on known or unknown quality of data**	**Planned restrictions in use of the data due to questions about data quality**

19. Data Management

To meet the requirements of the General QAPP, the following data management activities shall be followed for the _____ project *(check all that apply):*

- ❑ Field samplers shall record data on field sheets, review them, sign and turn over to field coordinator.
- ❑ Field Coordinator shall review sheets and confers with samplers on any needed corrective action.
- ❑ Field samplers shall fill out the chain-of-custody form for forwarding the processed samples to the laboratory.
- ❑ Each person who handles or transports samples shall also sign the custody form upon receipt of the samples.
- ❑ Chain of custody forms will follow samples to the lab and back to Monitoring Coordinator by mail or pickup after each analysis run is completed.
- ❑ Once laboratory analyses are complete, the laboratory personnel shall mail lab results to the Monitoring Coordinator or arrange for pickup.
- ❑ The Monitoring Coordinator and/or Data Entry Coordinator will enter raw field and lab data into the project computer system.
- ❑ Computer-entered data shall then be compared with field sheets for accuracy.
- ❑ Original data sheets will be stored at *(specify):* _____
- ❑ Disk back-ups and copies of the data sheets will be made and stored in a separate location designated by the Monitoring Coordinator. *(Provide details):*

  _____

  _____

  _____

- ❑ Documentation of data recording and handling, including all problems and corrective actions, shall be included in all preliminary and final reports.
- ❑ Data will be entered into one of the following digital data entry templates provided by CZM
  - ❑ CZM Water Quality Tool Pack
  - ❑ MarshDB
  - ❑ Marine Invader Database
- ❑ Examples of data forms and checklists are provided in Attachment C.
- ❑ Other _____

Data management systems - spreadsheets, databases, statistical or graphical software packages, location of data records (paper and electronic), are described here:

Table 19.1. Data Management, Review, Validation, Verification Process Summary

Activity	By whom	Corrective action, if needed
Example: Check labels just prior to sampling, to ensure correct labeling of container.	Field sampler	Correct label or change container

20. Assessment and Response Actions

To comply with the requirements of the General QAPP, the Monitoring Coordinator, QA Officer and TAC (as applicable) will use the following process to identify and effectively address any issues that affect data quality, personal safety, and other important project components.

The Monitoring Coordinator will periodically check to see the following:

- □ Monitoring is occurring as planned;
- □ Sufficient written commentary and supporting photographs exist;
- □ Sufficient volunteers are available;
- □ Volunteers have been observed as they sample their sites;
- □ Samplers are collecting in accordance with project schedules;
- □ Data sheets and custody control sheets are being properly completed and signed off;
- □ Data are properly interpreted;
- □ Plans for dealing with adverse weather are in place;
- □ Retraining or other corrective action is implemented at the first hint of non compliance with the QAPP or SOPs;
- □ Labs are adhering to the requirements of their QAPP, in terms of work performed, accuracy, acceptable holding times, timely and understandable results and delivery process;
- □ Data management is being handled properly, i.e. data are entered on a timely basis, are properly backed up, are easily accessed, and raw data are properly stored in a safe place;
- □ Procedure for developing and reporting the results exists.
- □ Other _____

Table 20.1 describes possible assessment methods and corrections and who will implement the action to assure program integrity.

Table 20.1. Assessment and Response Action

Activity	By whom	Corrective action, if needed
Example: Review precision results for each field sampler.	Monitoring Coordinator	Retrain/replace volunteers, discard bad data

21. Reports

To comply with the requirements of the General QAPP, the following reporting mechanisms will be used.

☐ The final report will describe the program's goals, methods, quality control, results, data interpretation, and recommendations and include

- □ Raw data,
- □ QC data
- □ Associated metadata
- □ Questionable data flagged
- □ Preliminary or final report label
- □ Other:_____

☐ The final report will be sent to the QAPP and *General QAPP Adoption Form* distribution lists and submitted to CZM and/or DEP following DEP guidelines CN 0.74 *Recommended Content of 3rd Party Data* and CN 0.78 *Data Deliverable Guidelines for Grant Projects* (see General QAPP Appendix 3).

Table 21.1 describes the reporting mechanism for this project's data, who is responsible for completion and distribution, and to whom each report will be distributed.

Table 21.1. Report Mechanisms, Responsibilities, and Distribution

Reporting Mechanism	By Whom	Distribution
Example: Annual monitoring report.	Monitoring Coordinator	Distribution list. Public by being posted on the organization's web site, being shared with the local media, by donating to town library.

22. Data Review, Validation and Verification Requirements

☐ To comply with the requirements of the General QAPP, all project data, metadata and quality control data shall be critically reviewed by the Monitoring Coordinator and QA Officer to determine if there are any problems that compromise data usability.

Describe the process.

23. Validation and Verification Methods

☐ To comply with the requirements of the General QAPP, all project data and metadata are reviewed and approved as usable data or as un-usable when the data are questionable for any reason.

☐ Data validation and verification will occur as described in Table 19.1, and will include checks on:

- ☐ Completion of all fields on data sheets; missing data sheets
- ☐ Completeness of sampling runs (e.g. number of sites visited/samples taken vs. number proposed, were all parameters sampled/analyzed?)
- ☐ Completeness of QC checks (e.g. number and type of QC checks performed vs. number/type proposed)
- ☐ Number of samples exceeding QC limits for accuracy and precision and how far limits were exceeded.
- ☐ Other _____

24. Reconciliation with Data Quality Objectives

To comply with the requirements of the General QAPP, at the conclusion of the sampling season (i.e., after all in-season quality control checks, assessment actions, validation and verification checks and corrective actions have been taken), the resulting data set will be compared with the program's data quality objectives (DQOs).

This review will include, for each parameter, calculation of the following:

- ☐ Completeness goals: overall % of samples passing QC tests versus number proposed in Element 7
- ☐ Percent of samples exceeding accuracy and precision limits
- ☐ Average departure from accuracy and precision targets.
- ☐ Other _____

☐ After reviewing these calculations, and taking into consideration such factors as clusters of unacceptable data (e.g. whether certain parameters, sites, dates, volunteer teams etc. produced poor results), the Monitoring Coordinator, QA Officer and TAC members (as applicable) will evaluate overall program attainment of DQOs and determine what limitations to place on the use of the data, or if a revision of the DQOs is allowable.

☐ Other _____

The following process describes how project data are compared to the program's data quality objectives (DQOs) and the mechanisms used to accomplish it.

Attachments

Attachment A. Sampling methods
Attach all Standard Operating Procedures written for your program.

Attachment B. Analytical methods
Attach all Standard Operating Procedures written for your program, including Standard Operating Procedures written by laboratories conducting analyses for your program and for specific parameters being analyzed for your program. Also include individual laboratory Quality Assurance Plans for participating laboratories.

Attachment C. Data forms and checklists
Attach all field data forms and checklists used for your program.

End of General Quality Assurance Project Plan Adoption Form

Appendix 2. Selected references to specific field methods

(References to trade names, commercial products and manufacturers in this QAPP do not constitute endorsement.)

Water Sampling:

River and Lake:

- Massachusetts Water Watch Partnership, 2003. Sampling Protocols. http://www.umass.edu/tei/mwwp/protocols.html Blaisdell House, UMass Amherst MA 01003
- A Citizen's Guide to Understanding and Monitoring Lakes and Streams, WA. State Ecology, 1991
- Vermont Volunteer Surface Water Monitoring Guide http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_monitoringguide.htm
- Volunteer Lake Monitoring A Methods Manual. US EPA http://www.epa.gov/OWOW/monitoring/volunteer/lake/
- Volunteer Stream Monitoring: A Methods Manual, 1997 USEPA and Ocean Conservancy http://www.epa.gov/owow/monitoring/volunteer/stream/
- Volunteer Estuary Monitoring. A Methods Manual. 2nd Edition. US EPA and Ocean Conservancy http://www.epa.gov/owow/estuaries/monitor/
- MassWWP Standard Operating Procedure Lakes-1 For Locating Sampling Site. Revision 0. http://www.umass.edu/tei/mwwp/acrobat/L1site.pdf
- MassWWP Standard Operating Procedure Lakes-2 For Lake Depth Determination. Revision 0 http://www.umass.edu/tei/mwwp/lakedepth.html
- MassWWP Standard Operating Procedure Lakes-3 For Secchi Disk Transparency Revision 0 http://www.umass.edu/tei/mwwp/acrobat/L3secchi.pdf
- MassWWP Standard Operating Procedure Lakes-4 For Dissolved Oxygen Revision 0 http://www.umass.edu/tei/mwwp/acrobat/L4DO.pdf
- MassWWP Standard Operating Procedure Lakes-5 For Temperature Revision 0 http://www.umass.edu/tei/mwwp/laketemp.html
- MassWWP Standard Operating Procedure Lakes-6 For pH and Alkalinity Revision 0 http://www.umass.edu/tei/mwwp/acrobat/L6pH.pdf
- MassWWP Standard Operating Procedure Lakes-7 For Total Phosphorus Revision 1 http://www.umass.edu/tei/mwwp/acrobat/L7-P.pdf
- MassWWP Standard Operating Procedure Lakes-8 For Chlorophyll *a* Revision 0 http://www.umass.edu/tei/mwwp/acrobat/L8chlorophyll.pdf
- MassWWP Standard Operating Procedure Lakes-9 For Bacteria Revision 0 http://www.umass.edu/tei/mwwp/acrobat/L9-bacteria.pdf
- MassWWP Standard Operating Procedure Rivers-1. For Temperature. Revision 0 http://www.umass.edu/tei/mwwp/acrobat/R1temp.pdf
- MassWWP Standard Operating Procedure Rivers-2. For Dissolved Oxygen. Revision 0 http://www.umass.edu/tei/mwwp/acrobat/R2DO.pdf
- MassWWP Standard Operating Procedure Rivers-3 For Bacteria. Revision 0 http://www.umass.edu/tei/mwwp/acrobat/R3bacteria.pdf
- US EPA Volunteer Stream Monitoring A Methods Manual
- http://www.epa.gov/volunteer/stream/

Probes:

- Standard Operating Procedures for Calibrating and Field Measurement Procedures for the YSI Model 6 Series Sondes and Datalogger, revision 7, 2005; USEPA Office of Environmental Measurement and Evaluation http://www.epa.gov/NE/about/oemechart.html
- SOP for Multi-Probe Use; CN 4.21; MassDEP-DWM
- SOP for Multi-Probe Deployments for Unattended Logging; CN 4.4; MassDEP-DWM http://www.mass.gov/dep/water/index.htm

- Office of Surface Water Technical Memorandum 99.06: Care and Maintenance of Vertical Axis Current Meters. USGS 1999. http://water.usgs.gov/admin/memo/SW/sw99.06.html

Flow:

- RIFLS River Instream Flow Stewards Quality Assurance Project Plan, 2003 Riverways Programs MA Department of Fish and Game
- SOP for Flow Measurement; CN 68.0; MassDEP-DWM

Beaches:

- Guidance for Bacteria Sampling at Beaches, CN 104.0; Mass DEP-DWM
- Time Relevant Beach & Recreational Water Quality Monitoring and Reporting, EPA/625/R-02/017, October, 2002
- Data Quality Objectives and Statistical Design Support for Development of a Monitoring Protocol for Recreational Waters, USEPA Contract 68-D4-0091; prepared by Research Triangle Institute, 9/99
- National Beach Guidance and Required Performance Criteria for Grants; USEPA. June 2002

Benthics and habitat assessments:

- Field and Laboratory Methods for Macroinvertebrate and Habitat Assessment of Low Gradient, Nontidal Streams, 1997; Mid-Atlantic Coastal Streams Workgroup
- Generic QAPP Guidance for Programs using Community Level Biological Assessment in Wadable Streams and Rivers, USEPA. 1995 (EPA 841-B-95-004)
- Living Waters: Using Benthic Macroinvertebrates and Habitat to Assess Your River's Health; Geoff Dates, River Network Portland, Oregon U.S.A.
- Massachusetts Leaders Manual to Coordinating a Volunteer Lake Watershed Study, 2003. Massachusetts Riverways Program. http://www.mass.gov/dfwele/river/pdf/lakewatershedleadersmanual.pdf
- Massachusetts Stream Crossings Handbook, 2005. Massachusetts Riverways Program. Singler, A. and Graber, B. (editors). http://www.mass.gov/dfwele/river/pdf/stream_crossings_handbook.pdf
- New England Freshwater Wetlands Invertebrate Biomonitoring Protocol, 2000; UMass Extension. Hicks, Anna.
- Rapid Bioassessment Protocols For Use in Streams and Wadeable Rivers: Periphyton, Benthic Macroinvertebrates, and Fish, Second Edition, 1999; USEPA Office of Water; EPA 841-B-99-002; Barbour et al.
- Shoreline Survey – A Stream Team Monitoring Project Leader's Manual. 2000. Massachusetts Riverways Program. Kimball, Joan. http://www.mass.gov/dfwele/river/pdf/rivintro.pdf
- Soft-Bottom Coastal Stream Monitoring Protocol, Fairfax Watershed Watch ; Fairfax County Volunteer Stream Monitoring Program, Northern Virginia Soil and Water Conservation District
- http://www.dec.state.ny.us/website/dow/stream/orderpageone.htm (pictoral key to freshwater benthic macroinvertebrates)

Pollution Source Tracking:

- Illicit Discharge Detection and Elimination Manual, A Handbook for Municipalities, January 2003. NEIWPCC
- Illicit Discharge Detection and Elimination, Center for Watershed Protection and Robert Pitt, October, 2004 http://www.cwp.org/
- Massachusetts Estuaries Project Wet / Dry Weather Bacteria Sampling Techniques and Protocol, Mass DEP/UMass-Dartmouth SMAST, 2003
- Microbial Source Tracking Guide Document, USEPA, Office of research and Development, June, 2005
- Surface Water Monitoring Guide, ISCO http://www.isco.com/Stormwater/default.asp?url=/stormwater5/Default.asp&lead=9252

Miscellaneous methods, manuals, etc.:

- A Citizen's Guide to Understanding and Monitoring Lakes and Streams, WA. State Ecology, 1991
- Illicit Discharge Detection and Elimination Manual, A Handbook for Municipalities, January 2003. NEIWPCC

- Illicit Discharge Detection and Elimination, Center for Watershed Protection and Robert Pitt, October, 2004 http://www.cwp.org/
- Massachusetts Estuaries Project Wet / Dry Weather Bacteria Sampling Techniques and Protocol, Mass DEP/UMass-Dartmouth SMAST, 2003
- Microbial Source Tracking Guide Document, USEPA, Office of research and Development, June, 2005
- Surface Water Monitoring Guide, ISCO http://www.isco.com/Stormwater/default.asp?url=/stormwater5/Default.asp&lead=9252
- Vermont Volunteer Surface Water Monitoring Guide http://www.anr.state.vt.us/dec/waterq/lakes/htm/lp_monitoringguide.htm
- Volunteer Estuary Monitoring. A Methods Manual. 2nd Edition. US EPA and Ocean Conservancy http://www.epa.gov/owow/estuaries/monitor/
- Volunteer Lake Monitoring A Methods Manual. US EPA http://www.epa.gov/OWOW/monitoring/volunteer/lake/
- Volunteer Stream Monitoring: A Methods Manual, 1997 USEPA and Ocean Conservancy http://www.epa.gov/owow/monitoring/volunteer/stream/

Wetlands Monitoring:

- *A Volunteer's Handbook for Monitoring New England Salt Marshes.* Massachusetts Office of Coastal Zone Management, Boston, MA. 2002
- *Field Indicators for Identifying Hydric Soils in New England*, NEIWPCC, April, 2004
- *Tidal Crossing Handbook: A Volunteer Guide to Assessing Tidal Restrictions*. Parker River Clean Water Association, Byfield, MA.
- *Coastal Wetland Plants of the Northeastern United States*. R. Tiner. 1987. The University of Massachusetts Press, Amherst, MA.
- *The Ecology of Atlantic Shorelines*. M.D. Bertness. 1999. Sinauer Associates, Sunderland, MA.
- *A Practical Guide to the Marine Animals of Northeastern North America*. L.W. Pollack. 1998. Rutgers University Press, New Brunswick, NJ.
- *Marine Animals of Southern New England and New York: Identification keys to common nearshore and shallow water macrofauna*. H.M. Weiss. 1995. Bulletin115. State Geological and natural History Survey of Connecticut, Department of Environmental Protection, Hartford, CT.
- *A Field Guide to Atlantic Coast Fishes (North America)*. C.R. Robins & G.C. Ray. 1986. The Peterson Guide Series, Houghton Mifflon Company, Boston MA.
- *National Audubon Society Sibley Guide to Birds*. D.A. Sibley. 2000. Alfred A. Knopf, Inc.

Eelgrass Monitoring:

- Short, F.T., L.J. McKenzie, R.G. Coles, and K.P. Viler. 2002. SeagrassNet Manual for Scientific Monitoring of Seagrass Habitat. QDPI, QFS, Cairns. 56pp.
- McKenzie, L.J., R.L. Yoshida, R.G. Coles, and J.E. Mellors. 2005. Seagrass-Watch. www.seagrasswatch.org. 144pp.
- For monitoring water clarity, light intensity, and PAR near eelgrass:
- Carruthers, T.J.B., B.J. Longstaff, W.C. Dennison, E.G. Abal and K. Aioi. 2001. Chapter 19: Measurement of light penetration in relation to seagrass. In, F.T. Short and R.G. Coles (editors), Global Seagrass Research Methods. Elsevier Sicence B.V. 369-392.

Marine Introduced Species Monitoring:

- Volunteer Estuary Monitoring: A Methods Manual, 2nd edition, USEPA and Ocean Conservancy
- Marine Introduced Species Monitoring Resource Center. Salem Sound Coastwatch. www.salemsound.org/mis/miscenter.htm

- A Citizen's Guide to Monitoring Marine Invasive Species. B. Warren. 2005. Salem Sound Coastwatch http://www.salemsound.org/SSCW_MIS_Monitoring_Guide.pdf

Appendix 3. Selected references to specific lab methods

(References to trade names, commercial products and manufacturers in this QAPP do not constitute endorsement.)

Water Analysis:

General methods:

- Standard Methods for the Examination of Water and Wastewater, 21st Edition. Greenberg, Arnold, et al. American Water Works Association. 2005
- Methods for Chemical Analysis of Water and Wastes, EPA 600/4-79-020, Revised 1983. USEPA. Clesceri, L.S., A.E. Greenberg, and A.D. Eaton, (editors).
- APHA/AWWA/WEF. 1998. Standard Methods for the Examination of Water and Wastewater, 20th Edition, American Public Health Association, American Waterworks Association and Water Environment Federation, Washington.
- EPA/600/R-97/072. Methods for the Determination of Chemical Substances in Marine and Estuarine Environmental Matrices – 1997, 2nd Edition; National Exposure Research Laboratory Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268

Bacteria (including human vs. non-human source research):

- Analytical Quantification of Escherichia coli and Enterococci Bacteria in Ambient Surface waters using an Enzyme Substrate Test (SM 9223B); MassDEP-DWM
- Bernhard, A.E. and Field, K.G. 2000. A PCR assay to discriminate human and ruminant feces on the basis of host differences in *Bacteroides-Prevotella* genes encoding 16S rRNA. Appl. Environ. Microbiol. 66(10): 4571-4574.
- Scott, T. M., Jenkins, T.M., Lukasik, J., and Rose, J.B. 2005. Potential use of a host associated molecular marker in *Enterococcus faecium* as an index of human fecal pollution. Environ. Sci. Technol. 39(1): 283-287.
- Tang, et al 2005. Validation of a Potential Human Fecal Pollution Marker Based on a Putative Virulence factor (ESP Gene) in Enterococcus faecium and its Application to the Assessment of the Charles River and Boston Harbor Beaches, Massachusetts.

Chlorophyll a:

- UMass Environmental Analysis Lab, Analytical methods: SOP for Chlorophyll *a* Analysis. University of Massachusetts, Amherst MA 01003. 2003.
- CN 3.4; Chlorophyll *a* Analysis. MassDEP-DWM. 627 Main St., 2nd floor, Worcester, MA 01608
- EPA/600/R-97/072. Methods for the Determination of Chemical Substances in Marine and Estuarine Environmental Matrices – 1997, 2nd Edition; National Exposure Research Laboratory Office of Research and Development U.S. Environmental Protection Agency Cincinnati, Ohio 45268 (also in Misc.)

Nitrogen

- Standard Operating Procedure for Total Kjeldahl Nitrogen (Lachat Method). Revision 2. Grace Analytical Lab, 536 South Clark Street, 10th Floor, Chicago, IL 60605. 1994 http://www.epa.gov/grtlakes/lmmb/methods/tknalr2.pdf
- ESS Method 220.3: Ammonia Nitrogen and Nitrate + Nitrite Nitrogen, Automated Flow Injection Analysis Method. Environmental Sciences Section, Inorganic Chemistry Unit, Wisconsin State Lab of Hygiene. 465 Henry Mall, Madison, WI 53706. 1991. http://www.epa.gov/grtlakes/lmmb/methods/methd220.pdf
- Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water, WRIR 03-4174, USGS, 2003

Optical Brighteners and Fluorescent Whitening Agents (FWAs):

- Hagedorn, C., et al, 2005. Fluorometric Detection of Optical Brighteners as an Indicator of Human Sources of Water. Crop and Soil Environmental News.

  http://www.ext.vt.edu/news/periodicals/cses/2005-11/part1.html (Part 1)

  http://www.ext.vt.edu/news/periodicals/cses/2005-11/part2.html (Part 2)

- Poiger, T., Field, J.A., Field, T.M., and Giger, W. 1996. Occurrence of fluorescent whitening agents in sewage and river water determined by solid-phase extraction and high-performance liquid chromatography. Environ. Sci. Technol. 30:2220-2226.
- Quality Assurance Project Plan. Optical Brightening Study- Green Hill Pond, Ninigret Pond, Factory Brook, Teal Brook. Rhode Island Department of Environmental Management May 2001.
- Water Sampling guide, including Optical Brightener sampling; Eight Towns and the Bay; http://www.naturecompass.org/8tb/sampling/index.html

Pharmaceuticals and Personal Care Products (PPCPs):

- Alvarez, et. Al 2004. Water Quality Monitoring of Pharmaceuticals and Personal Care Products Using Passive Samplers http://www.epa.gov/esd/chemistry/ppcp/images/alvarez.pdf
- Glassmeyer, et al, 2005 Transport of Chemical and Microbial Compounds from Known Wastewater Discharges: Potential for Use as Indicators of Human Fecal Contamination; Environ. Sci. Technol. 39, 5157-5169

Total Phosphorus:

- Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water, WRIR 03-4174, USGS, 2003

Toxicity:

- IQ-Toxicity Test (one hour Daphnia test with fluorescence end point); Kingswood Diagnostics, LLC
- Toxtrak (bacterial inhibition with colorimetric end-point); Hach

Appendix 4. Selected references to Quality Assurance Project Plans, Sampling and Analysis Plans, water quality data reports, other useful documents

- CN 0.71 Data Submittal Guidelines. MA DEP-DWM. 627 Main St., 2nd floor, Worcester, MA 01608
- CN 0.74 Recommended Content of 3rd Party Data. MA DEP-DWM. 627 Main St., 2nd floor, Worcester, MA 01608
- CN 0.76 QAPP Approval & Data Review Process. DEP-DWM. 627 Main St., 2nd floor, Worcester, MA 01608
- CN 0.78 Data Deliverable Guidelines for Grant Projects. MA DEP-DWM. 627 Main St., 2nd floor, Worcester, MA 01608
- Jones River Marine Ecology Center Water Quality Monitoring Program Sampling and Analysis Plan. 2006. http://www.jonesriver.org/
- Coastal Zone Management Coastal Pollution Remediation Grant Program http://www.mass.gov/czm/cprgp.htm
- Coastal Zone Management Wetlands Restoration Program http://www.mass.gov/czm/wrp/
- Executive Office of Environmental Affairs Watershed Action Plans http://www.mass.gov/envir/water/publications.htm
- Massachusetts Aquatic Invasive Species Management Plan http://www.mass.gov/czm/invasivemanagementplan.htm
- Massachusetts Beaches Act http://www.mass.gov/legis/laws/seslaw00/sl000248.htm
- MA DEP 305(b) waterbody health assessments http://www.mass.gov/dep/water/resources/wqassess.htm
- MA DEP Total Maximum Daily Load reports http://www.mass.gov/dep/water/resources/tmdls.htm
- The Massachusetts Volunteer Monitor's Guide to Quality Assurance Project Plans. Massachusetts Department of Environmental Protection. 2001. Godfrey, P. et al. http://www.mass.gov/dep/brp/wm/files/qapp.pdf
- Sampling and Analysis Plan Form for use with the Massachusetts Volunteer Coastal Monitoring General QAPP. Massachusetts office of Coastal Zone Management and Department of Environmental protection. 2006. Schoen, J. and Warren, B. http://www.mass.gov/czm/
- Sampling and Analysis Plan, Coastal Habitat Marine Introduced Species Monitoring Program. Salem Sound Coastwatch. 2006. Warren, B. http://www.salemsound.org/chimp.htm
- Sampling and Analysis Plan, Mount Hope Bay Estuarine Monitoring. The School for Marine Science and Technology. 2004. Howes, B. and Samimy, R.
- Sampling and Analysis Plan, South Coastal Basin Estuaries Monitoring. The School for Marine Science and Technology. 2004. Howes, B. and Samimy, R.
- US EPA Guidance on Choosing a Sampling Design for Environmental Data Collection For Use in Developing a Quality Assurance Project Plan. 2002. http://www.epa.gov/quality/qs-docs/g5s-final.pdf
- US EPA National Estuary Program Comprehensive Conservation and Management Plans http://www.epa.gov/owow/estuaries/ccmp/
- US EPA Region 1 Examples of Quality Assurance Project Plans http://www.epa.gov/region01/measure/qapp_examples/index.html
- US EPA Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) with Guidance; Quality Assurance Program United States Environmental Protection Agency Region IX 75 Hawthorne Street San Francisco, CA 94105 March 1997
- US EPA The Volunteer Monitor's Guide to Quality Assurance Project Plans. 1996. http://www.epa.gov/OWOW/monitoring/volunteer/qappcovr.htm
- US EPA The Volunteer Monitor Newsletter http://www.epa.gov/owow/monitoring/volunteer/vm_index.html

Appendix 5. Laboratories that may provide services for volunteer monitoring groups in coastal areas

This listing is current as of 12-28-2005. A searchable online list of labs certified by DEP in one or more analyses can be found on DE P Wall Experiment Station's web site: http://edep.dep.mass.gov/labcert/labcert.aspx

Northeast Region

Mass Lab ID	Lab Name	Street	City, State, Zip	Phone	Website
MA069	America Science Team Boston Inc	8 School St	Weymouth, Ma 02189-8951	(781) 337-9334	www.amerisci.com
751	Amesbury WTP Lab	Rings Corner-Newton Rd	Amesbury, Ma 01913-0000	(978) 388-0853	
MA005	Andover Water Treatment Plant Lab	397 Lowell St	Andover, Ma 01810-0000	(978) 623-8350	www.northandoverwaterdept.com/Water%20TreatmentFY03.htm
MA016	Billerica Water Treatment Plant Lab	250 Boston Rd	North Billerica, Ma 01862-0000	(978) 671-0957	www.mwpca.org/billerica.htm
MA026	Biomarine Inc	16 East Main St	Gloucester, Ma 01930-0000	(978) 281-0222	www.biomarinelab.com/
MA149	Cambridge Water Department Laboratory	250 Fresh Pond Pkwy	Cambridge, Ma 02138-0000	(617) 349-4780	www.cambridgema.gov/CWD/ops_quality.cfm
MA018	Danvers Water Division Laboratory	30 Lake St	Middleton, Ma 01949-0000	(978) 774-5054	
24353	G And L Labs Inc	33 Newport Ave	North Quincy, Ma 02171-0000	(617) 328-3663	
MA015	Geolabs Inc	45 Johnson Ln	Braintree, Ma 02184-0000	(781) 848-7844	www.geolabs.com/
MA066	Greater Lawrence Sanitary District	240 Charles St	North Andover, Ma 01845-0000	(978) 685-1612	www.glsd.org/
MA067	Haverhill Water Dept Lab	131 Amesbury Rd	Haverhill, Ma 01830-0000	(978) 374-2385	
24653	Louanis Treatment Plant	Strout Ave	Reading, Ma 01867-1251	(781) 942-9199	
MA128	Lowell Regional Wastewater Utility Lab	451 First Street Blvd Rte 110	Lowell, Ma 01850-0000	(978) 970-4248	
MA120	Lynn Water Treatment Plant Laboratory	390 Parkland Ave	Lynn, Ma 01905-0000	(781) 595-5200	
3561	MA State Laboratory Food Microbiology	305 South St	Jamaica Plain, Ma 02130-0000	(617) 983-6651	
MA099	Methuen Water Treatment Plant	25 Burnham Rd	Methuen, Ma 01844-0000	(978) 983-8845	
MA153	MWRA Central Laboratory	Deer Is Treatment Plant	Winthrop, Ma 02152-0000	(617) 660-7803	www.mwra.state.ma.us/04water/html/testinglabs.html
27451	MWRA Chelsea Laboratory	2 Griffin Way	Chelsea, Ma 02150-0000	(617) 305-5644	
MA072	New England Chromachem Inc	6 Nichols St	Salem, Ma 01970-1368	(978) 744-6600	www.chromachem.com/
20651	Newburyport WTP Lab	7 Spring Ln	Newburyport, Ma 01950-0000	(978) 465-4466	
21054	North Andover WTP Lab	420 Great Pond Rd	North Andover, Ma 01845-0000	(978) 688-9574	
MA123	Northeast Environmental Lab	10 R Rainbow Terrace	Danvers, Ma 01923-0000	(978) 777-4442	
MA034	S P Engineering Inc	45 Congress St	Salem, Ma 01970-0000	(978) 745-4569	

Mass Lab ID	Lab Name	Street	City, State, Zip	Phone	Website
MA126	Tewksbury WTP	71 Merrimack Dr	Tewksbury, Ma 01876-1070	(978) 858-0345	
10752	West Gloucester WTP	372 Magnolia Ave	Gloucester, Ma 01930-0000	(978) 281-9794	
22951	West Peabody WTP	38 Butternut Ave	Peabody, Ma 01960-0000	(978) 536-5069	

Southeast Region

Mass Lab ID	Lab Name	Street	City, State, Zip	Phone	Website
MA030	Alpha Woods Hole Lab	375 Paramount Dr	Raynham, Ma 02767-0000	(508) 822-9300	
MA022	Analytical Balance Corp	422 West Grove St	Middleborough, Ma 02346-0000	(508) 946-2225	www.h2otest.net
1651	Attleboro Water Treatment Facility	1296 West St	Attleboro, Ma 02703-0000	(508) 222-0019	
MA009	Barnstable County Health & Env Dept	3195 Main St	Barnstable, Ma 02630-0000	(508) 375-6606	
4453	Brockton Water Treatment Plant	Rte 36 And Cinder Rd	Pembroke, Ma 02359-0000	(781) 294-8597	
5551	Chatham Water Quality Laboratory	283 George Ryder Rd	Chatham, Ma 02633-0000	(508) 945-5165	www.town.chatham.ma.us/public_documents/chathamma_waterquality/waterquality
MA063	Envirotech Laboratories Inc	8 Jan Sebastian Dr	Sandwich, Ma 02563-0000	(508) 888-6460	
MA103	Groundwater Analytical Inc	228 Main St	Buzzards Bay, Ma 02532-0000	(508) 759-4441	www.groundwateranalytical.com
12251	Hanover WTP	40 Pond St	Hanover, Ma 02339-0000	(781) 826-3189	
14653	Ma Division Of Marine Fisheries	50 A Portside Dr	Pocasset, Ma 02559-0000	(508) 563-1779	www.mass.gov/dfwele/dmf/facilitiesandproperties/pocaoff.htm#p
17155	Morrell Associates Inc	1661 Ocean St	Marshfield, Ma 02050-0000	(781) 837-1395	www.morrell-associates.com/laboratory.htm
19751	Nantucket Environmental Laboratory	16 Boynton Ln	Nantucket, Ma 02554-0000	(508) 228-1338	
MA011	Quittacas WTP Lab	1 Negus Way	East Freetown, Ma 02717-0000	(508) 763-2231	
27351	Somerset WTP Laboratory	3249 County St	Somerset, Ma 02726-0000	(508) 674-4215	
14652	Taunton Water Treatment Plant	91 Precinct St	Lakeville, Ma 02347-0000	(508) 947-0690	
MA1084	Wampanoag Environmental Laboratory	Herring Creek Rd	Aquinnah, Ma 02535-0000	(508) 645-2903	www.dukescounty.org/Pages/DukesCountyMA_Environment/water_test

Note: Check which analyses an individual lab is certified for. Lab certification is not required, but is recommended where possible.

Appendix 6. Miscellaneous contacts: agencies, training organizations, volunteer monitoring groups

Coastal Zone Management:

- Jason Baker 251 Causeway Street, Suite 800, Boston, MA 02114. (617)- 626-1204 jason.baker@state.ma.us
- Todd Callaghan 251 Causeway Street, Suite 800, Boston, MA 02114 (617) 626-1233 todd.callaghan@state.ma.us
- Bruce Carlisle 251 Causeway Street, Suite 800, Boston, MA 02114 (617) 626-1205 bruce.carlisle@state.ma.us

Department of Conservation and Recreation:

- Anne Monnelly, Aquatic Ecologist, Office of Water Resources. 251 Causeway Street, Suite 600, Boston MA 02114. (617) 626-1395 anne.monnelly@state.ma.us

Department of Environmental Protection:

Regional Offices:

- Northeast Region: 205-B Lowell St. Wilmington, MA 01887 (978) 694-3200
- Southeast Region: 20 Riverside Dr. Lakeville, MA 02347 (508) 946-2700

DEP contacts (627 Main St., 2nd floor, Worcester, MA 01608):

- Richard Chase. (508) 767-2859. richard.f.chase@state.ma.us
- Arthur Screpetis. (508) 767-2875 Arthur.Screpetis@state.ma.us

Massachusetts Riverways Program:

- Department of Fish & Game, 251 Causeway St., Suite 400, Boston, MA 02114
  Margaret Kearns. (617) 626-1540. Margaret.Kearns@state.ma.us

Volunteer Monitoring contacts:

- Bridgewater State Watershed Access Lab. Biology Department, Bridgewater State College, Bridgewater, MA 02325. Kevin Curry kcurry@bridgew.edu
- Charles River Watershed Association.. 48 Woerd Avenue, Waltham, MA 02453. http://www.crwa.org Anna Eleria. 781-788-0007x225. aeleria@crwa.org.
- Massachusetts Water Watch Partnership. Blaisdell House, UMass, Amherst MA 01003. http://wwp.masswwp.org. 413-545-5532. Jerry Schoen. jschoen@tei.umass.edu.
- Neponset River Watershed Association. 2173 Washington Street, Canton, MA 02021. http://www.neponset.org . 781-575-0354 Peter Chandonait. chandonait@neponset.org
- Organization for the Assabet River. 9 Damon Mill Square Suite 1E Concord, MA 01742. http://www.assabetriver.org/. 978-369-3956. Suzanne Flint. oar@assabetriver.org.
- Salem Sound Coastwatch. 201 Washington Street, Suite 9 Salem, MA 01970. http://www.salemsound.org 978-741-7900. Barbara Warren barbara.warren@salemsound.org.
- School for Marine Science and Technology. 706 South Rodney French Blvd. New Bedford MA 02744. http://www.smast.umassd.edu/ . Roland Samimy, Research Manager. 508-910-6314. rsamimy@umassd.edu
- Waquoit Bay National Estuarine Research Reserve. PO Box 3092, 149 Waquoit Highway, Waquoit, MA 02536. http://www.waquoitbayreserve.org/. Laurie Tompkins 508-457-0495 Waquoit.Bay@state.ma.us

Appendix 7. Select list of suppliers of sampling probes, kits, etc.

This list in part courtesy of *Vermont Volunteer Surface Water Monitoring Guide*

Acorn Naturalists Science and environmental education resources, including field kits for schools 155 El Camino Real Tustin, CA 92780 1-800-422-8886 www.acornnaturalists.com	**Hydrolab** Sampling instruments Hach Environmental Headquarters P.O. Box 389 Loveland, CO 80539 1-800-949-3766 ext 1 http://www.hydrolab.com/
Ben Meadows Company Equipment and supplies for a variety of outdoor work, including water sampling P.O. Box 5277 Janesville, WI 53547-5277 1-800-241-6401 www.benmeadows.com	**In-Situ, Inc.** Sampling instruments 221 East Lincoln Ave. Fort Collins, CO 80524 1-800-446-7488 http://www.in-situ.com/
Carolina Biological Supply Curriculum supplements and monitoring equipment for schools 2700 York Court Burlington, NC 27215 1-800-334-5551 www.carolina.com	**LaMotte** Water quality testing equipment 802 Washington Ave. P.O. Box 329 Chestertown, Maryland 21620 1-800-344-3100 www.lamotte.com
Eureka Environmental Engineering Sampling instruments, software 2113 Wells Branch Parkway Suite 4400 Austin, TX 78728 1-512-302-4333 http://www.eurekaenvironmental.com/	**Water Monitoring Equipment and Supply (Lawre Enterprises of Maine)** Lake, stream, and pond/vernal pool monitoring equipment P.O. Box 344 Seal Harbor, Maine 04675 207-276-5746 www.watermonitoringequip.com
Fisher Scientific Full range of monitoring instruments ands supplies 2000 Park Lane Pittsburgh PS 15275 1-800-766-7000 http://www.fisherscientific.com/	**Wildlife Supply Wildco** Aquatic sampling instruments and equipment 301 Cass St. Saginaw, MI 48602-2097 1-800-799-8301 www.wildco.com
HACH Company Analyzers, instruments, and chemistries for water analysis P.O. Box 389 Loveland, Colorado 80539 1-800-227-4224 www.hach.com	**YSI Environmental** Equipment, supplies and instruments for environmental monitoring 1700/1725 Brannum Land Yellow Springs, OH 45387 1-800 897-4151 www.ysi.com
Healthy Water Healthy People Manuals, curriculum and field kits available 201 Culbertson Hall PO Box 170575 Montana State University Bozeman, MT 59717-0575 www.HealthyWater.org	

Appendix 8. Marine introduced species verification, handling, and disposal procedures

Based on the Hitchhiker Sighting and Verification Instructions:
http://massbay.mit.edu/exoticspecies/hitchhikers/index.html
Table A-7, below lists species likely to be encountered during marine invasive species monitoring efforts and the necessary verification protocols. Verification and vouchering protocols associated with each species should be followed during field sampling. The paragraphs following the table provide more information on species verification methods, handling, and disposal. When collecting live specimens, or shells, keep only the minimum necessary for identification and vouchering purposes. Living or dead specimens collected in the field and removed from a site should never be returned to any water body (see disposal guidelines, below).

Marine Introduced Species Verification Requirements (as of 4/2006).

List of Introduced Species present in Massachusetts		Possible for Volunteers to ID	Voucher for Each Sighting	Verification Method	Identification Source
Chlorophyceae					
1	*Codium fragile* ssp. *tomentosoides*	Yes	No	P	**Guide to Marine Invaders in the Gulf of Maine*
Rhodophyceae					
2	*Dumontia contorta*	Yes	No	P	*Peterson Field Guide to the North Atlantic*
3	*Grateloupia turuturu*	Yes	Yes	D/P	**Guide to Marine Invaders in the Gulf of Maine*
4	*Lomentaria clavellosa*	?	Yes	D/P	**This alga can grow up to 15.75 inches (40 cm) and has a hollow main stalk, which is soft and gelatinous. It is bright to dark red in color and is found in shallow waters, occasionally on mussels or other seaweeds.
5	*Neosiphonia harveyi*	?		D/P	***A* bushy red alga growing up to 16 inches (40.5 cm) that most likely originated in Japan. Its current range is from Newfoundland to South Carolina. It is a weedy, fouling species associated with boating and aquaculture. Common Name: filamentous red alga
Porifera					
6	*Halichondria bowerbanki*	?	?	P	**This sponge usually forms colonies south of Cape Cod. It has a wide variety of colors and may be brown, yellow, olive green, or bronze. Older colonies have finger-like 8mm projections. Colonies will form on rocks, algae, and pilings in the intertidal zones or lower. Common Name: bread-crumb sponge

Cnidaria Hydrozoa					
7	*Cordylophora caspia*	?	Yes	?	**This light brown hydroid colony can grow up to 10 cm and lives in fresh to brackish (0-20 psu salinity) waters. Global distribution has expanded, presumably due to increased boat travel and ballast water exchange. *Cordylophora* alters community structure, and negatively affects populations of ciliates and bryozoans, while attracting barnacles, amphipods, and polycheates. *Cordylophora* has also become a problem for power plants and irrigation systems by clogging pipes and filters.
8	*Garveia franciscana*	?	?	?	**First identified in 1902, it has only recently been found in New England. Its ecological impact includes: competition, habitat change, and predation. Its economic impact includes: water-pump failures, increase in cleaning frequency at inlets, and decreasing efficiency of deoxygenating towers.
Cnidaria Anthozoa					
9	*Diadumene lineata*	Yes	No	P	**Guide to Marine Invaders in the Gulf of Maine*
10	*Sagartia elegans*	Yes	No	P	**Guide to Marine Invaders in the Gulf of Maine*
Polychaeta					
11	*Janua pagenstecheri*	No	Yes	P	**A relatively small polychaete that lives in a spiral calcareous tube. This is a very obscure species and there is relatively little information to provide.
Mollusca: Nudibranchis (sea slugs)					
12	*Thecacera pennigera*	Yes	Yes	P	**Originally found in the Atlantic coast of Europe, it is now seen in Africa, the Middle east, Japan, Brazil, and Australia. It's size ranges from is usually 15mm to 30mm long. Its color is usually a spotted, brown and orange appearance. (formerly known as *Spirobus pagenstecheri*)
Mollusca: Bivalvia					
13	*Ostrea edulis*	Yes	No	P/S	**Guide to Marine Invaders in the Gulf of Maine*
Arthropoda: Isopoda					
14	*Ianiropsis* sp.	No	Yes	P	**A new introduction, although it probably has been in Massachusetts and Rhode Island for several years. It is not easy to identify from available keys and we know very little about its habitat preferences, life history, and interaction with native species.

Arthropoda: Amphipoda					
15	*Caprella mutica*	Yes	Yes	A/P	**A large amphipod native to East Asia and Siberia that has been introduced to North America probably through either ballast water or through shipments of Japanese oysters. During the summer months it can be very abundant. Common Name: skeleton shrimp
16	*Microdeutopus gryllotalpa*	No	Yes	P	**This amphipod is found in lagoons, salt marshes, among algae, shells, polzoans, tunicates etc., high detritus accumulation.
Arthropoda: Decapoda					
17	*Carcinus maenas*	Yes		P/C	**Guide to Marine Invaders in the Gulf of Maine*
18	*Hemigrapsus sanguineus*	Yes		P/C	**Guide to Marine Invaders in the Gulf of Maine*
Arthropoda: Insecta					
19	*Anisolabis maritime*	Yes	Yes	A/P	**A brownish to black earwig up to 20mm in size. It is common on the shore under rocks. It is distinguished by its 24 segments, antennae, and lack of wings. Common Name: maritime earwig
Bryozoa Entoprocta					
20	*Barentsia benedini*	?	?	?	**An Entoproct with creeping growth composed of 5-10 stalks. It is tolerant of pollution and usually grows on piers and harbors pilings in sheltered bays and estuaries.
21	*Bugula neritina* x xx	Yes	Yes	A/P	**This bryozoan has flexible, bushy colonies, purplish to purplish brown in color, and can grow up to 4 inches (10 cm). Found in harbors and estuaries, it attaches itself to hard substrata. Much biochemical research has been conducted on this species as a source of bryostatin, a compound shown to be effective against leukemia.
22	*Membranipora membranacea*	Yes	Yes	A/P	**Guide to Marine Invaders in the Gulf of Maine*
Urochordata: Tunicata					
23	*Ascidiella aspersa*	Yes	Yes	A/P	**Guide to Marine Invaders in the Gulf of Maine*
24	*Botrylloides violaceus*	Yes	No	P	**Guide to Marine Invaders in the Gulf of Maine*
25	*Botryllus schlosseri*	Yes	No	P	**Guide to Marine Invaders in the Gulf of Maine*
26	*Didemnum* sp.	Yes	Yes	A/P	**Guide to Marine Invaders in the Gulf of Maine*
27	*Diplosoma listerianum*	Yes	Yes	A/P	**Guide to Marine Invaders in the Gulf of Maine*
28	*Styela clava*	Yes	No	P	**Guide to Marine Invaders in the Gulf of Maine*
	P=photo A=collected in vial with alcohol		* *Guide to Marine Invaders in the Gulf of Maine* at http://www.salemsound.org/chimp.htm		
	D=dried specimen C=carapace S=shell		**Notes from *MIT Sea Grant Hitchhikers Guide to Exotic Species* http://massbay.mit.edu/exoticspecies/exoticmaps/descriptions_intro.html		

List of Introduced Species with Potential to Come to Massachusetts Waters		Possible for Volunteers to ID	Voucher for Each Sighting	Verification Method	Identification Source
Rhodophyceae					
1	*Grateloupia turuturu*	Yes	Yes	D/P	*Guide to Marine Invaders in the Gulf of Maine
Phaeophyceae					
2	*Sargassum muticum*	Yes	Yes	D/P	*Guide to Marine Invaders in the Gulf of Maine
3	*Undaria pinnatifida*	Yes	Yes	D/P	*Guide to Marine Invaders in the Gulf of Maine
Mollusca: Bivalvia					
4	*Rapana venosa*	Yes	Yes	S/P	*Guide to Marine Invaders in the Gulf of Maine
Arthropoda: Decapoda					
5	*Hemigrapsus takanoi*	Yes	Yes	A/P	*Guide to Marine Invaders in the Gulf of Maine
6	*Eriocheir sinensis*	Yes	Yes	A/P	*Guide to Marine Invaders in the Gulf of Maine
Cirripedia (Barnacles)					
7	*Elimius modestus*	Yes	Yes	A/P	** Usually smooth edges, 4 plates up to 1 in (2.5 cm). Native to New Zealand & Australia, but anticipated introduction from Europe. Attaches to hard surfaces in the intertidal.
8	*Chthamalus fragilis*				**Gray, beige or brown in color it can grow up to 1cm in diameter. It is common on south Cape Cod where it lives on rocks and other hard surfaces at high-tide levels. Common Name: down-under barnacle
Arthropoda: Isopoda					
9.	*Synidotea laevidorsalis*	Yes	Yes	A/P	*Guide to Marine Invaders in the Gulf of Maine
Urochordata: Tunicata					
10	*Corella eumyota*	Yes	Yes	A/P	*Guide to Marine Invaders in the Gulf of Maine
11	*Styela canopus*	Yes	?	A/P	**This tunicate or sea squirt arrived from the Pacific around 1852. It has a rough, leathery, reddish tunic, is about 1 inch long, and is found in southern New England. It probably arrived by ship fouling. Common Name: rough sea tunicate

P=photo A=collected in vial with alcohol	* *Guide to Marine Invaders in the Gulf of Maine* at http://www.salemsound.org/chimp.htm
D=dried specimen C=carapace S=shell	**Notes from *MIT Sea Grant Hitchhikers Guide to Exotic Species* http://massbay.mit.edu/exoticspecies/exoticmaps/descriptions_intro.html

Taking Photographs

Since the photograph is for species identification, it needs to be as clear as possible to give others a better chance of identifying the species from the photograph. Center the species in the photograph and have the organism fill the image area as much as possible. If possible, include an object in the photo that will help give a sense of scale so the size of the specimen may be estimated. Use a ruler or other

measuring device, or if this is not available a coin, pen or other object may be used. Most point and shoot cameras take fuzzy pictures if you are closer than three feet from the specimen. Make sure the image is in focus. The photograph should be at 250 or 300 dpi (dots per inch) and in the 4 x 6 inch range for size and clearly labeled with date, time, location and observer.

Collecting Shells/ Dried Specimens
Dried specimen may be collect for some species verification. They should be placed in a box to avoid having the specimen crushed during transport or handling. Specimen should be clearly labeled with date, time, location and observer.

Collection Permits
The monitoring organization shall obtain all scientific collecting permits required by law. In Massachusetts the Department of Marine Fisheries issues a **Special License for Scientific Collection,** which is required prior to collecting marine specimens. Contact Todd Callaghan at CZM (617-626-1233) to see if your organization is covered by CZM's group collection permit. Otherwise, contact the Division of Marine Fisheries, 251 Causeway Street, Suite 400, Boston MA 02114, phone 617-626-1520 or see the following website http://www.mass.gov/dfwele/dmf/commercialfishing/permit_index.htm (see Special Permits) for information on scientific collection permits.

Collecting and Preserving Live Specimens
When sampling, follow personal safety precautions and attempt to minimize the impacts of collection on the sampling area. When collecting live specimens keep only the minimum necessary for identification and vouchering purposes. To preserve a specimen, place the specimen in a jar or bottle with a tight fitting lid and fill it with isopropyl alcohol (available at any drug store). The alcohol does not have to come to the very top of the container, but cover the specimen completely. Specimen should be clearly labeled with date, time, location and observer. If mailing, place the closed container inside one or two plastic bags just in case the container leaks. If possible, send the container in a small box containing tissue paper, paper towels, bubble wrap or left over packing peanuts.

Proper Disposal of Live or Dead Specimen
Remember to properly dispose of any specimen that has been collected and is no longer needed. Once an organism has been removed from a site, alive or dead, it should not be returned to any water body. All specimens to be discarded should be placed in a bag or container filled with bleach and disposed of in a trash receptacle.

Appendix 9. Examples of labels, forms, training records, data sheets

Sample Training Record Form

Organization Name Training Record

Training topic	Provided by	Training Date	Personnel Trained	Personnel Function	Training Record Location

Example Lake Volunteer Monitoring Program

Field Data Sheet - 200X

Date: _____ Primary Sampler: _____

Site Number: _____ Additional Samplers: _____

Site Name: _____ _____

Time: _____ _____

Weather Conditions

Sky: _____

Wind: _____

Air Temp.(circle °C or °F): _____

Weather conditions during the prior 72 hours: _____

_____

Lake Conditions

Water Temp #1 (circle °C or °F) _____ **Water Temp #2** (°C or °F) _____

Lake level at dam spillway (according. to gauge) _____

Secchi Disk Procedure

Secchi Disk Depth at mid lake Site (meters) Rep #1 _____ #2:_____

Viewscope: Yes / No Sunglasses: Yes / No

Lake Depth at mid lake Site (meters): _____

Sample ID, handling

T.P. Bottle ID Numbers: _____ Chlorophyll ID Numbers: _____

Coliform Bottle ID Numbers: _____

Remember: Use ink pen only. Cross out (do not erase) and correct errors. Initial any corrections made.

COMMENT SECTION

Please record any unusual circumstances under which data was collected, such as unusual odors, algae mats in the vicinity of the sampling site, a floating oily sheen, or other environmental settings that may influence or explain the conditions under which the samples were collected.

Also, please record any unusual circumstances that may have occurred when you took the samples, such as the sample bottle or the Secchi disk hitting the bottom and suspending sediment, or the freezer containing the samples may have defrosted. In recording these unusual circumstances, please state any actions taken to rectify the situation in an attempt to obtain and maintain the most accurate data results. For example, if the sample bottle hit the bottom of the lake, state what actions were taken, such as "the bottle was rinsed in clear lake water three times to clear the bottle of sediment."

Remember: Your job is to collect the most accurate water quality data possible.

If there is ANY doubt as to the validity of your samples, please notify Program Coordinator immediately!

Example Lake Volunteer Monitoring Program 200X

Field Data Sheet - Tributary Sampling for Total Phosphorus

SITE NAME:_____ SITE NUMBER: _____

DATE:_____ TIME:_____

VOLUNTEERS:_____

WEATHER OBSERVATIONS (check appropriate boxes):
Weather now: □ Clear □ Partly Cloudy □ Overcast □ Cloudy □ Drizzle □ Raining □ Other

Air Temperature: _____°C

Weather past two days: _____
If it has rained in past two days, estimate amount of precipitation:_____inches
Was the rain □ light, □ moderate, or □ heavy?

WATER OBSERVATIONS (check appropriate boxes):
Water color :□ clear □ cloudy □ muddy □ green □ brown □ tea colored □ iridescent

□other:_____

Water odor: □ none □ rotten egg □ gasoline □ sewage □ detergent □ fishy

□other:_____

Any floating debris? (Describe):_____

STREAM USE OBSERVATIONS

Any human use of stream?

Describe:_____

Any livestock or wildlife?

Describe:_____

Comments:_____

Example Lake 200X Sampling Program
DO - Secchi Data Sheet

Date: _____ Analyst: _____

Water Body:_____

Quality Control

QC Sample ID **DO**	Digits of Titrant	Measured D.O. (mg/l)

Field Samples

Sample ID & Replicate #	Secchi Depth (m)	Depth to Bottom (m)	Depth of Sample(m)	Temp. (EC)	Digits of Titrant	Measured DO (mg/l)

Example Lake Sampling Program
200X Lab Data Sheet – Fecal Coliform Bacteria

Date: _____ Sampler: _____

Analyst: _____

Water Body:_____

Fecal Coliform Sample Results

Sample ID & Replicate #	Volume ml	Count	Colonies/ 100 ml

Sample bottle label

For fecal coliform, total phosphorous, chlorophyll

Site Location _____

Site No. _____ Sample Type:_____

am

Date: _____ Time: _____pm

mm/dd/yr

Preservation Method: _____

Sampler's Name _____

Label to be placed on aluminum foil containing filter with chlorophyll sample

Lake name:_____
Site location_____
Site No._____ Date:_____
Volume of water filtered:_____
Sampler's name:_____

Chain of Custody Form

Organization:_____

Name of Lab:_____

Sampler's Signature:_____ _____

Sample IDs	Site name/ number	Date, Time	Type	#Bottles	Analyses	Comments

Relinquished by: Signature	Received by: Signature	Condition when received (i.e. warm, cool, frozen)	Date/Time
Relinquished by: Signature	Received by: Signature	Condition when received (i.e. warm, cool, frozen)	Date/Time
Relinquished by: Signature	Received by: Signature	Condition when received (i.e. warm, cool, frozen)	Date/Time
Relinquished by: Signature	Received by: Signature	Condition when received (i.e. warm, cool, frozen)	Date/Time

Additional Comments:

AQUATIC MACROPHYTE
OBSERVATION TALLY SHEET

LAKE/POND: ______________________________ DATE: _______________

COLLECTORS: ____

TOTAL OBSERVATIONS: ____

SPECIES NAME	OBSERVATION TALLYS	TOTAL

AQUATIC MACROPHYTE
FREQUENCY OF OCCURRENCE
(# Observations / Total Observations x 100)

Lake/Pond: **Date:** **Collectors:**

Species Name	0-20%	21-40%	41-60%	61-80%	81-100%

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Example River Monitoring Program

FIELD DATA SHEET

SITE NAME:_____ SITE NUMBER: _____

DATE:_____ TIME:_____

VOLUNTEERS:_____

WEATHER OBSERVATIONS (check appropriate boxes):
Weather now: □Clear □Partly Cloudy □Overcast □Cloudy □Drizzle □Raining □Other:

Air Temperature: _____°C Time:_____

Weather past three (3) days: _____
If it has rained in past three days, estimate amount of precipitation:_____inches
Was the rain □light, □moderate, or □heavy?

WATER OBSERVATIONS (check appropriate boxes):
Water level (on reference object compared to low-flow water level):
_____
Water color: □clear □cloudy □muddy □green □brown □tea colored □iridescent
□other:_____
Water odor: □none □rotten egg □gasoline □ sewage □detergent □fishy
□other:_____
Water Temperature: _____°C Thermometer Number: _____
Any floating debris? (describe):_____

RIVER USE OBSERVATIONS (check appropriate boxes):
□swimming □wading □boating □fishing □picnic □hanging out □other:_____

Any wildlife? Describe:_____

SAMPLES TAKEN (check appropriate boxes):
□bacteria – time of sample collection: _____ □pH/alkalinity – time of sample collection:_____

Comments:_____

Forms. Example Lab Data Sheet – DO, pH, Alkalinity analysis

LAB ANALYSTS:_____
DATE:_____

Sample ID	Begin Time	pH	Digits to 4.5	Digits to 4.2	Alkalinity (mg/l)

Forms. Example Rain gage log.

Location:_____
Observer:_____

Start date*	Start time*	End date	End time	Rainfall amount (in.)

* The start date and start time will typically be the same as the previous end date and end time.

Bacteria Sampling Lab Notebook Example

Analyst	Project	Test	Lab ID	OWM ID	Sample Date	Sample Time	Sample Receipt Date & Time	Analysis Date	Analysis Start Time	Media Lot #	Dilution	Incubator #	Incubation Start Time & Temp	Incubation End Time & Temp	UV Reader	# of large yellow wells	# of small yellow wells	Total Coliform MPN	# of large fluores wells	# of small fluores wells	E. coli MPN
J. Doe	River Source Tracking	Colilert	L04-01-01	51-587	2/12/04	12:45	2/12; 1:50	2/12/04	2:24	368-01	0	1	4:35; 35.5	4:45; 35.0	R. Chase	14	14	67	7	7	34
			L04-01-02	51-587	2/12/04	12:45		2/12/04	2:26	368-01	10		4:35; 35.5	4:45; 35.0		2	2	8	1	1	5
			L04-01-03	51-588	2/12/04	12:55		2/12/04	2:29	368-01	0		4:35; 35.5	4:45; 35.0		37	37	287	26	26	211
			L04-01-04	51-588	2/12/04	12:55		2/12/04	2:31	368-01	10		4:35; 35.5	4:45; 35.0		4	4	27	4	4	27
			L04-01-05	51-588	2/12/04	12:55		2/12/04	2:35	368-01	100		4:35; 35.5	4:45; 35.0		0	0	0	0	0	0
			L04-01-06	51-589	2/12/04	1:25		2/12/04	2:45	368-01	0		4:35; 35.5	4:45; 35.0		9	9	49	5	5	32
			L04-01-07	51-590	2/12/04	1:25		2/12/04	2:47	368-01	10		4:35; 35.5	4:45; 35.0		2	2	8	2	2	8
			L04-01-07D	51-590 Lab Dup	2/12/04	1:25		2/12/04	2:48	368-01	10		4:35; 35.5	4:45; 35.0		3	3	15	2	2	8
			L04-01-08	Lab Blank	2/12/04	2:58		2/12/04	3:05	368-01	0		4:35; 35.5	4:45; 35.0		0	0	0	0	0	0
			L04-01-09	E. coli +	2/12/04	2:59		2/12/04	3:10	368-01	0		4:35; 35.5	4:45; 35.0		59	59	---	59	59	---

Example Incubator Temperature Log

TEMPERATURE LOG

Date	Time	Incubator TEMP, deg. C	TEMP (other)	Temp Dial Setting	Initials	Comments
4/5/04	9:15	35.5	35.0	1.6	rc	

* Record before, during and after incubations. See lab coordinator if adjustment needed.